MOTOROLA

NATIONAL SERVICE TECHNICIAN'S GUIDE

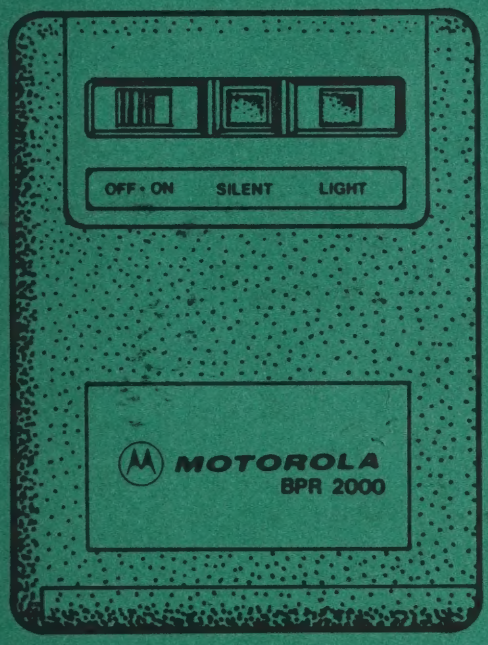
$5.50

Paging Products

Servicing

"BPR 2000"

Display Pagers



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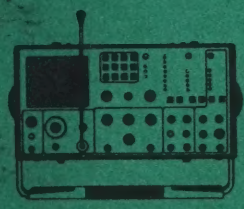

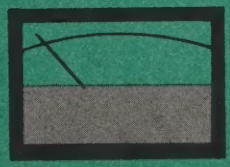

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PLANTATION, FL

PAGING PRODUCTS

SERVICING

"BPR 2000"

DISPLAY PAGERS

A01 - A03 - A04 SERIES

PREPARED BY
NATIONAL SERVICE TRAINING CENTER
PLANTATION, FLORIDA
JULY, 1984

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I. INTRODUCTION

The "BPR 2000" Series Display Pager is Motorola's first entry into the field of high capacity numeric display paging. The "BPR 2000" Display Pager employs a microcomputer-controlled decoder to perform the complex functions required for binary-digital paging. The unit is designed to work in a system utilizing Golay Sequential Code (GSC) signalling format, giving the system a code capacity of 1,000,000 unique pager codes. It is suggested that MAV-PACK 3/VID-953 covering Golay Sequential Coding be obtained and reviewed if the technician is not familiar with this encoding scheme.

The technician should not be apprehensive about analyzing the "BPR 2000" Display Pager; this task can be made a relatively efficient process by carefully following the procedures outlined in this Technician's Guide. Through the years, the Motorola National Service Training Department has addressed itself to the importance of developing effective pager servicing practices. It is our purpose here to consolidate the servicing details that are presented in the National Service Training Golay Sequential Code Paging Class and present it in an easy to use, quick reference form.

In Section II, the test equipment needed to properly service the "BPR 2000" Display Pager is listed. The importance of good test equipment cannot be overemphasized. The degree of circuit sophistication employed in modern day paging receivers demands high quality test equipment. The use of low grade, limited capability test equipment will only serve as a hindrance to efficient pager servicing. The equipment listed in this booklet has a proven track record of providing consistent, meaningful results.

Section III, Pager Service Aids, explains the need and function of specialized pager service aids. The only way to guarantee published Motorola pager specifications is through the proper use of appropriate service aids and adequate test equipment.

Section IV explains the application and function of the various pager performance tests that are applied in the final servicing section of this booklet. These tests will serve to insure proper pager operation, and also steer the technician to the appropriate troubleshooting procedures.

Section V of this booklet, the Servicing Section, has been included in order to provide you with detailed pager troubleshooting information. The servicing information has been arranged in an easy to use, consolidated format. These procedures are time proven, and will provide you with reliable results if properly performed with the recommended test equipment and service aids.

Section VI covers unique handling procedures that must be heeded to prevent damage to electrostatic discharge sensitive devices.

In pager servicing, the results that you obtain, as in any undertaking, are directly related to the effort extended. This booklet has been produced in order to help the technician extend maximum effort in servicing the "BPR 2000" Display Pager.

NOTE: This guide is designed to be used in conjunction with the following Motorola Service Manuals:

	Motorola Manual Number
Theory/Maintenance Manual	68P81032C70-0
33-50 MHz Service Manual	68P81032C45-0
148-174 MHz Service Manual	68P81032C40-B
450-465 MHz Service Manual	68P81030C55-0

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II. PAGER TEST EQUIPMENT

An important consideration when servicing the "BPR 2000" display pager is the judicious selection of the test equipment. The ease with which a pager malfunction can be analyzed is largely related to the abilities of the test equipment used.

It is recommended that the equipment listed here, or the equivalent, be used as a guide for the initial purchase of test equipment to set-up a pager repair position or for the replacement of existing equipment through normal attrition.

The equipment listed here has proven to be reliable and to yield consistent, meaningful results. All of the pager servicing data published in this guide was compiled using the test equipment outlined here.

SERVICE MONITOR OR SIGNAL GENERATOR
Used to generate carrier frequencies at accurate RF levels in order to perform reliable and consistent performance checks.

Motorola R-2200A Series Service Monitor

The following list of test equipment is duplicated in the R-2200A Service Monitor.

AC VOLTMETER For measuring pager second IF (M1) signal levels. Also used during pager alignment and performance checks. When making noise takeover measurements, an AC voltmeter with a measurement capability of -90 dBm is required; therefore, the AC voltmeter incorporated within the R-2200A is not recommended for this test. (R-2200A good to -40 dBm).

Hewlett-Packard 400FL AC Voltmeter

DC VOLTMETER For measuring module and discrete component supply voltages.

Motorola R-1001A Digital Multimeter

OSCILLOSCOPE Necessary for analyzing pager decoder waveforms.

Motorola R-1028A Oscilloscope
or Motorola R-1029A Oscilloscope
or Tektronix T921 Oscilloscope

The following items are not included in the R-2200A but are recommended for servicing the "BPR 2000" display pager.

LOW FREQUENCY COUNTER Used to count second IF frequency during carrier frequency alignment.

Motorola R-1027A Audio Counter

RF MILLIVOLTMETER Provides measurement capability for IF signal and oscillator injection voltages.

Motorola S-1339A RF Millivoltmeter

NOTE: This instrument is also available in a digital readout version, S-1340A. However, the analog version listed above is recommended for pager servicing.

IF SIGNAL SOURCE Used during alignment and receiver troubleshooting. International Crystal Mfg. Co. oscillator consisting of:

FOT-10 Housing
OT-14 Oscillator Board
17.9 MHz Crystal
14.575 MHz Crystal (Low Band, 33-37 MHz)

NOTE: The IF source listed above is not necessary if a synthesized signal generator which is capable of generating a 17.9 MHz (14.575 MHz) $\pm$ 100 Hz signal is available.

R-1800A SERIES DIGITAL ANALYZER CONTROLLER
This instrument forms the nucleus of a microprocessor based service system. The unit is designed to offer a full range of comprehensive, programmed testing and diagnostic functions. Through the use of pre-programmed application packages and special interface adaptors, the R-1800A performs the following service functions for the "BPR 2000" display pager:

GOLAY SEQUENTIAL CODE ENCODER Used to modulate the RF signal generator with the proper binary information to address a pager under test.

Motorola R-1801A (Attache style)
or Motorola R-1821A (Console style) Digital Analyzer Controller

Motorola RTL-4816A* Golay Sequential Code Application Kit

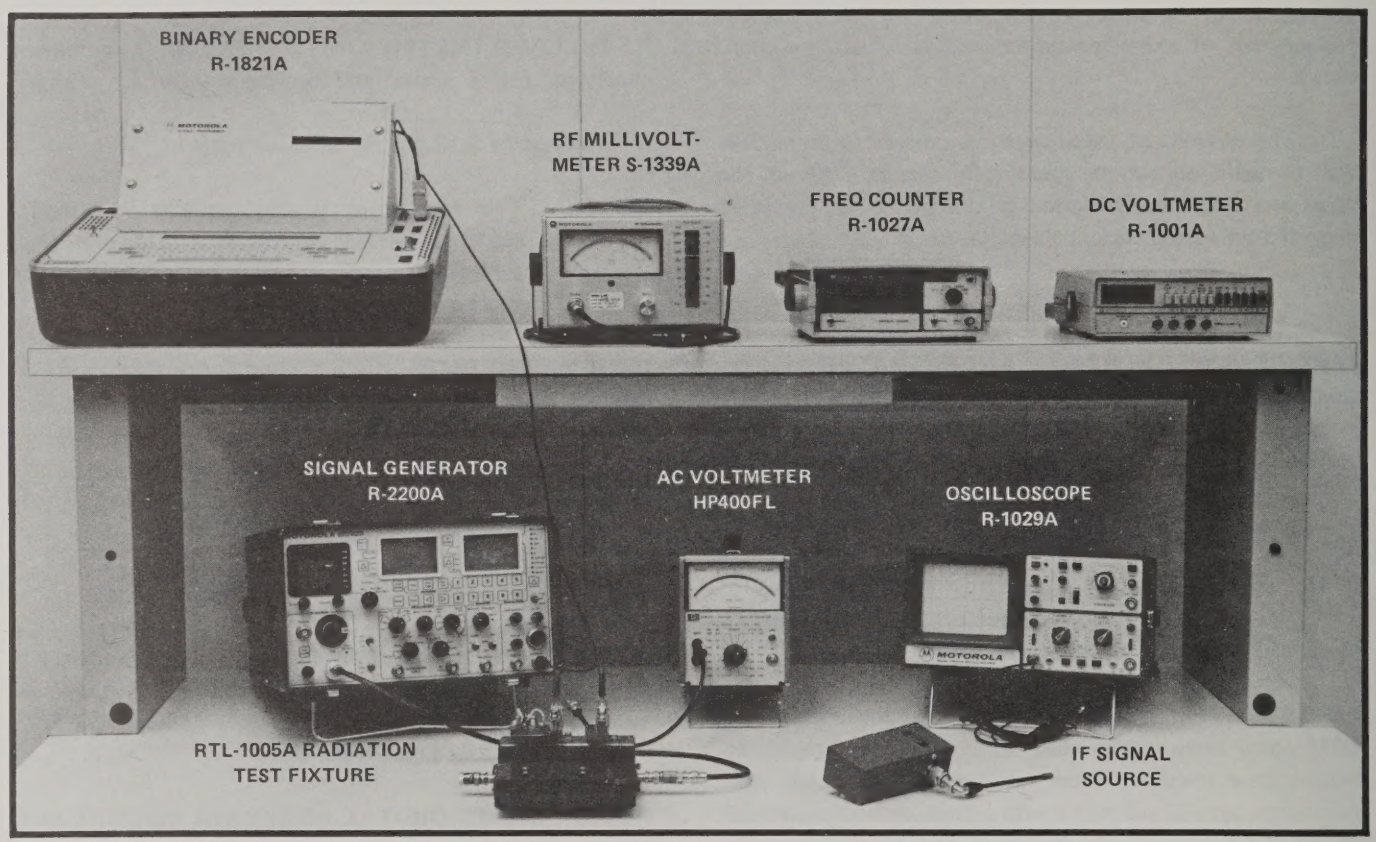
CODE PLUG PROGRAMMING The reader/programmer accessories enable the user to perform PROM programming in the field.

Motorola RTL-4817A* Application Program Kit
Motorola RTL-5808A* Adaptor Board

*These items are not included with the Digital Analyzer Controller.

SCREENROOMS The use of a screenroom when servicing Motorola pagers is highly recommended.

Pager servicing is often performed in areas located near the base station transmitter. This fact, in combination with the pager's RF sensitivity, can make performance or troubleshooting measurements difficult to perform. The screenroom helps eliminate extraneous RF signals from interfering with your measurements. The benefits gained from using a screenroom have been shown to greatly increase productivity in pager servicing.



TEST EQUIPMENT SET-UP FOR PAGER SERVICING

III.PAGER SERVICE AIDS

In addition to the test equipment outlined in the previous section, specialized equipment is required to properly service the "BPR 2000" display pager.

The following Service Aids allow the pager to be serviced under controlled conditions. Checking a pager by making off-the-air checks or holding it in the general vicinity of a signal generator will in no way yield a true indication of the pager's performance.

RTL-1005A UNIVERSAL RADIATION TEST FIXTURE The RTL-1005A radiation test fixture (shown in Figure 1) may be adapted to accommodate many pager models at a moderate cost. The test fixture is a precisely calibrated holding device designed for making pager performance tests under controlled conditions. Specifications such as paging sensitivity or 10 dB rise are based on the use of the radiation test fixture.

The concept of this fixture is based on producing a uniform radiation pattern around the pager when a signal generator is connected to the fixture. This pattern is produced by a 50 ohm transmission line-type radiation rod set in a corner reflector ground plane. This method of checking pager performance, as opposed to the 50 ohm or off-the-air check, is the only true way to judge a pager's performance.

The RTL-1005A differs from previous fixtures in that test heads with metering probes are not specifically constructed for each pager model. Instead, a universal head is supplied with an unformed probe set which may be bent by the user to make contact with the metering points on any Motorola pager. Additional probes (P/N 41-84208-D34) may be ordered from Motorola National Parts for the technician who only occasionally services different pager models or, for faster set-up, an entire test head with probes may be ordered as Kit Numbers 1V80304A65 (slotted bracket and clamp) and RTL-4062A (IF metering flap). The fixture comes equipped with the 50 ohm output termination (TEKA-99).

6 dB 50 OHM PAD (See Figure 1) This is a required accessory to the RTL-1005A radiation test fixture. It is used to terminate the input to the radiating element of the fixture. This allows the fixture's radiating element to appear as a 50 ohm input across a wide range of frequencies. Order separately as 58-80322A17.

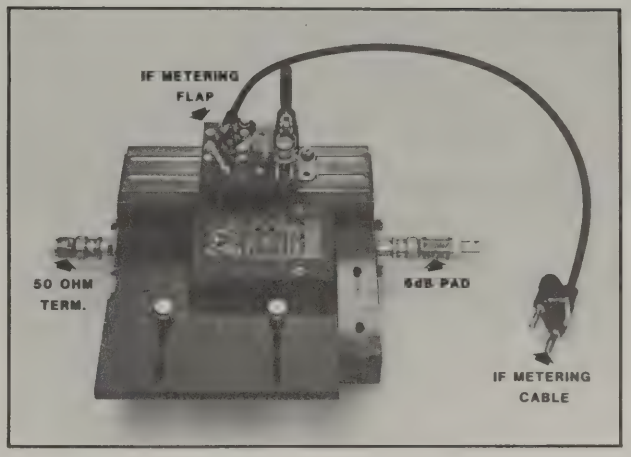


FIGURE 1. "BPR 2000" DISPLAY PAGER IN RADIATION TEST FIXTURE

IMPORTANT: The pager must be oriented in the fixture as shown above, during testing.

66-80329A63 ALIGNMENT TOOL This alignment tool is the standard ceramic tipped, non-metallic alignment tool and is recommended for aligning all Motorola paging products.

66-05799H01 CODE PLUG REMOVAL AND PAGER DISASSEMBLY TOOL This tool is used to extract the code plug from the pager through the battery compartment. Another important use for this tool is to remove the printed circuit board from the housing (see Figure 2).

FIGURE 2. CODE PLUG REMOVAL AND PAGER DISASSEMBLY TOOL

RTL-4107A ALIGNMENT/TROUBLESHOOTING HOUSING This test housing, shown in Figure 3, is used to align all "BPR 2000" display pagers. The test housing is a modified standard housing with the majority of the back removed in order to provide access to the foil side of the PC board. The removed area permits access to test points while simulating assembly pressure on the radio, which provides consistent final alignment in the customer's housing.

TT-901A PORTABLE PRODUCTS REPAIR GUIDE

This booklet covers such diverse aspects of repair as soldering irons, solder and correct use of both, as well as desoldering equipment, hand tools and chemicals for cleaning various parts of electronic products.

RSX-4014B PORTABLE ELECTROSTATIC PROTECTION KIT To prevent damage to sensitive CMOS devices from static discharge, it is recommended that this kit be employed when servicing "BPR 2000" display pagers. The kit consists of a bench top covering, a wrist strap and ground cord. The bench top covering is made of conductive plastic and incorporates pouches for carrying the wrist strap and ground cord. It also serves as an ideal wrapping for carrying printed circuit boards. The wrist strap uses a Velcro fastener to provide a comfortable but snug fit. The 15 foot ground cord bonds the bench covering and wrist strap to an electrical ground by means of an alligator clip and incorporates a one megohm resistor to limit current to a safe value.

For more information concerning static discharge protection, see Section VI of this publication.

FIGURE 3. ALIGNMENT/TROUBLESHOOTING HOUSING

IV. PAGER PERFORMANCE CHECKS

In the course of performing the pager troubleshooting procedures, as detailed in the Servicing Section of this booklet, certain pager performance checks are used.

It is the purpose of this section to acquaint you with the procedures and equipment used for making these checks. An understanding of the mechanics involved to perform these checks, along with proper interpretation of the results, is essential to efficient pager servicing.

RADIATED PAGING SENSITIVITY CHECK The radiated paging sensitivity check is a basic check of overall pager performance. The test is performed using a signal generator, the Golay Sequential Code Encoder (GSC), and the radiation test fixture.

With the GSC encoder connected to the signal generator, set the deviation for ± 4 KHz. Connect the RF output of the signal generator to the radiation input of the radiation test fixture. With the pager positioned in the fixture, the threshold of paging sensitivity can be found by reducing the RF signal generator output level to the minimum point that enables the alert tone on three consecutive applications of the pager code to the signal generator. The RF level required shall not exceed the radiated paging sensitivity specification for the pager under test.

Repeat the above procedure for all applicable call codes, verifying the pager's response to both tone only and tone and data paging messages.

If the pager fails the paging sensitivity check, the pager has either a receiver or decoder problem. However, if the pager's alert tone is produced at some higher than normal RF level, the decoder section of the pager is probably functioning properly. This is a good observation to make while performing this test as it will give you a clue to the pager's problem area if it fails to meet the radiated paging sensitivity specification.

NOTE: In order to properly perform the following checks, the circuit board and control head must be installed within the alignment housing and the battery saver circuitry must be overridden. Before any attempts are made to disassemble the pager, consult the service manual for the proper disassembly/reassembly procedures.

CAUTION

Review the electrostatic discharge protection procedures included in Section VI of this booklet.

To disable the battery saver circuitry, connect a 10K ohm resistor from U2 of Pin 9 to B+. (Not necessary if equipped with the Delete Battery Saver Option).

RADIATED 10 dB RISE CHECK The radiated 10 dB rise check is used to isolate a problem of poor overall paging sensitivity to the pager's receiver or decoder section. The results of this test will guide you to the proper troubleshooting procedures, receiver or decoder, as detailed in the Servicing Section of this booklet. The test equipment used consists of an RF signal generator, an AC voltmeter, and the radiation test fixture with the metering pin assembly.

The pager chassis is first installed within the alignment housing and then positioned in the radiation test fixture. Close the metering pin assembly so contact is made with the pager's second IF test point, M1. The IF test point cable from the metering pin assembly is then connected to the AC voltmeter. With NO RF applied to the radiation input of the test fixture, record the idle noise level at the pager's IF test point as indicated on the AC voltmeter. Now, slowly increase the RF output of the signal generator (no modulation) to a point that raises the signal level at M1 10 dB above the idle noise level recorded earlier. The amount of RF signal required to do this shall not exceed the radiated 10 dB rise specification for the pager under test.

If the RF signal level required to raise M1 by 10 dB is equal to or less than the given specification, the receiver section of the pager is good and troubleshooting of the pager's decoder section is indicated.

If the RF signal level required is more than the given specification, a receiver problem is indicated. If the pager marginally fails the radiated 10 dB rise check (less than 12 dB out of spec), realigning the pager may clear the problem. However, if the pager drastically fails the rise check, receiver troubleshooting is indicated and no attempt should be made to realign the pager.

NOISE TAKEOVER MEASUREMENTS Noise takeover measurements will be used in this booklet to perform troubleshooting checks on the pager's first mixer and RF amplifier circuitry. Experience has shown these checks to be easy to perform and yield meaningful results. Conventional stage gain measurements on the first mixer and RF amplifier are often difficult to perform with repeatable results due to the high frequency and low signal levels involved. Therefore, noise takeover measurements will be used to diagnose a pager receiver front-end problem.

In any pager, a small amount of noise is present at the input of the RF amplifier. This noise is amplified and applied to the following stages where it is further amplified and passed on. The contribution of each stage to the total noise produced at the second IF test point, M1, is an indication of the gain of that stage. The takeover procedure consists of measuring the noise level at the IF test point and then noting the drop in noise as selected stages are turned off. This drop in noise is related to the gain of the stage which has been turned off. In the "BPR 2000" pager, the stages can be turned off by shorting the input to ground. The only equipment required for the takeover procedure is a sensitive, high impedance AC voltmeter (sensitivity -90 dBm; input impedance at least 1 megohm; a Hewlett-Packard Model 400FL is recommended for takeover measurements) and a metal tipped tuning tool for shorting stage inputs.

CONVENTIONAL STAGE GAIN MEASUREMENTS

Conventional stage gain measurements are used to check the first and second IF stages of the pager's receiver section. These checks primarily consist of setting an input reference to the stage under test and then measuring the resultant output level. Each of the stages checked has a predictable amount of gain or loss. If a receiver stage is found to be out of specification, it is important to compare the amount of error indicated to the results of the 10 dB rise check. If, for example, the receiver failed 10 dB rise by 20 dB and a particular stage is out of specification by 3 or 4 dB, that stage is NOT the problem. Therefore, while going from stage to stage and making the various measurements, you must constantly compare your results to the results of the 10 dB rise check in order to properly identify the faulty stage.

V. SERVICING SECTION

This section of the booklet details the troubleshooting procedures for the "BPR 2000" A01, A03, and A04 series display pagers.

The troubleshooting information is divided into four sections. The first three sections are devoted to the A01, A03, and A04 receivers. The first page of each section contains a list of preliminary checks that are used to initially test the pager and ultimately guide you to the receiver or decoder troubleshooting procedures. Pager alignment procedures are also included in the event a "touch-up" of the pager's tuning is indicated. The remaining section details the servicing procedure for the decoder. Due to the commonality of the decoders (A01, A03, and A04 series), only one decoder section has been included.

The receiver and decoder troubleshooting procedures have been arranged to provide maximum convenience at the bench. With the booklet rotated and laid flat, the appropriate receiver troubleshooting procedures can be viewed, along with the matching schematic and component locator. The component locator is printed on a fold-out page and is used for both receiver and decoder troubleshooting procedures.

It should be noted that all signal levels are average readings compiled from engineering data and actual readings from properly aligned working radios. Where one signal level is given, it should be interpreted as a "ballpark reading" to indicate proper stage operation and not as an absolute minimum or maximum unless stated otherwise.

By carefully following the procedures detailed on the following pages, a pager malfunction can be quickly and efficiently located.

SPECIAL HANDLING PRECAUTIONS

The microcomputer (U5) and the display module (U6) are susceptible to damage in handling due to static discharge. Therefore, extreme care should be taken when handling and testing these devices. For more information concerning electrostatic discharge protection, see Section VI of this publication.

The LCD (U7) and the elastomers are prone to damage in handling due to contamination. Finger cots should be worn when handling these devices.

Maintain contamination-free integrity by servicing the control head and control head components only in a clean, dust-free environment.

When removing flux, do not use solvent around trim capacitors or tuning coils as the solvent and/or flux can permanently ruin these parts.

MODEL	FREQUENCY
A01	33 - 50 MHz
A03	138 - 174 MHz
A04	450 - 465 MHz

PAGER SPECIFICATIONS

Radiated Paging Sensitivity	10 uv
Radiated 10 dB Rise	40 uv

"BPR 2000" DISPLAY PAGER

A01 SERIES

SERVICE AIDS

Universal Radiation Fixture	RTL-1005A
50 Ohm Termination*	TEKA-99
IF Metering Flap*	RTL-4062A
Bracket and Clamp*	1V80304A65
6 dB 50 Ohm Pad	58-80322A17
Code Plug Removal/ Disassembly Tool	66-05799H01
Alignment/Troubleshooting Housing	RTL-4107A
Alignment Tool	66-80329A63
Portable Electrostatic Protection Kit	RSX-4014B

*Included with the RTL-1005A.

TROUBLESHOOTING PROCEDURE – PRELIMINARY CHECKS

1. Prior to starting any pager performance checks or troubleshooting procedures, the pager's battery voltage must be checked. Battery voltage should read greater than 1.1 VDC. This check should be made with the alert tone sounding (turn pager from OFF to ON) in order to provide a load to the battery.

   With a good battery installed in the pager, perform the radiated paging sensitivity check. The threshold sensitivity of the paging circuitry can be found by reducing the RF signal level to a point that enables the alert tone on three consecutive applications of the pager code to the signal generator. This level should not exceed 10 microvolts.

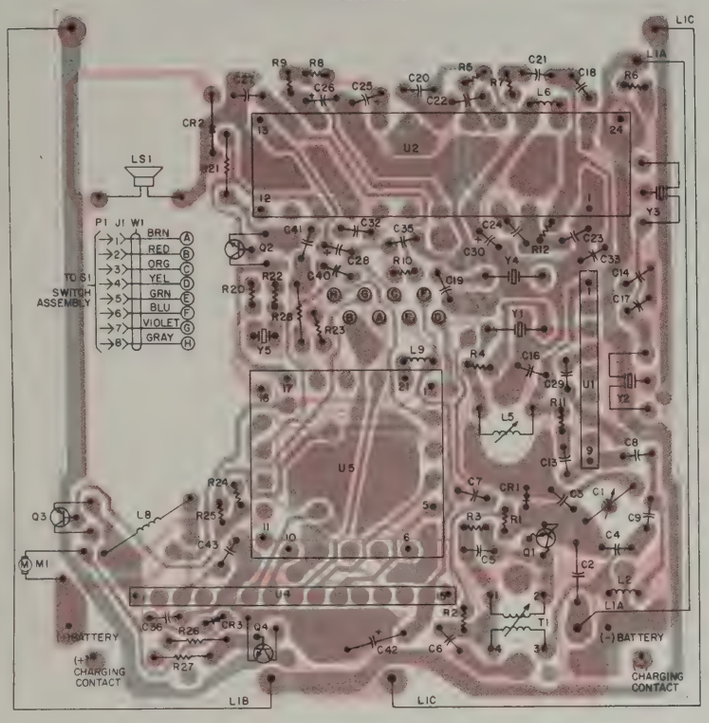
   NOTE: Check paging sensitivity for all applicable paging codes, verifying the correct response to both tone only and tone and data paging messages.

2. If the pager fails the paging sensitivity check, perform the radiated 10 dB rise check to isolate the problem area to the receiver or decoder.

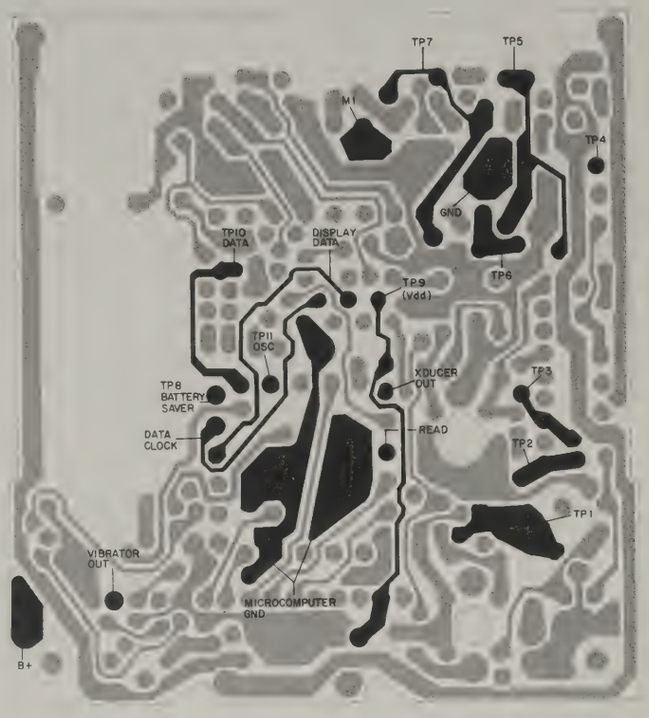
   It should take no more than 40 microvolts to obtain a 10 dB rise at IF test point (M1). If the pager passes the 10 dB rise check, go to the decoder troubleshooting procedure. If the pager drastically fails the 10 dB rise check (more than 100 microvolts), go to the receiver troubleshooting procedures. If the pager marginally fails the 10 dB rise check (less than 100 microvolts), try realigning the pager and perform the 10 dB rise check again. If little or no improvement is attained, go to the receiver troubleshooting procedure.

A01 SERIES COMPONENT LOCATOR

VIEWED FROM SOLDER SIDE

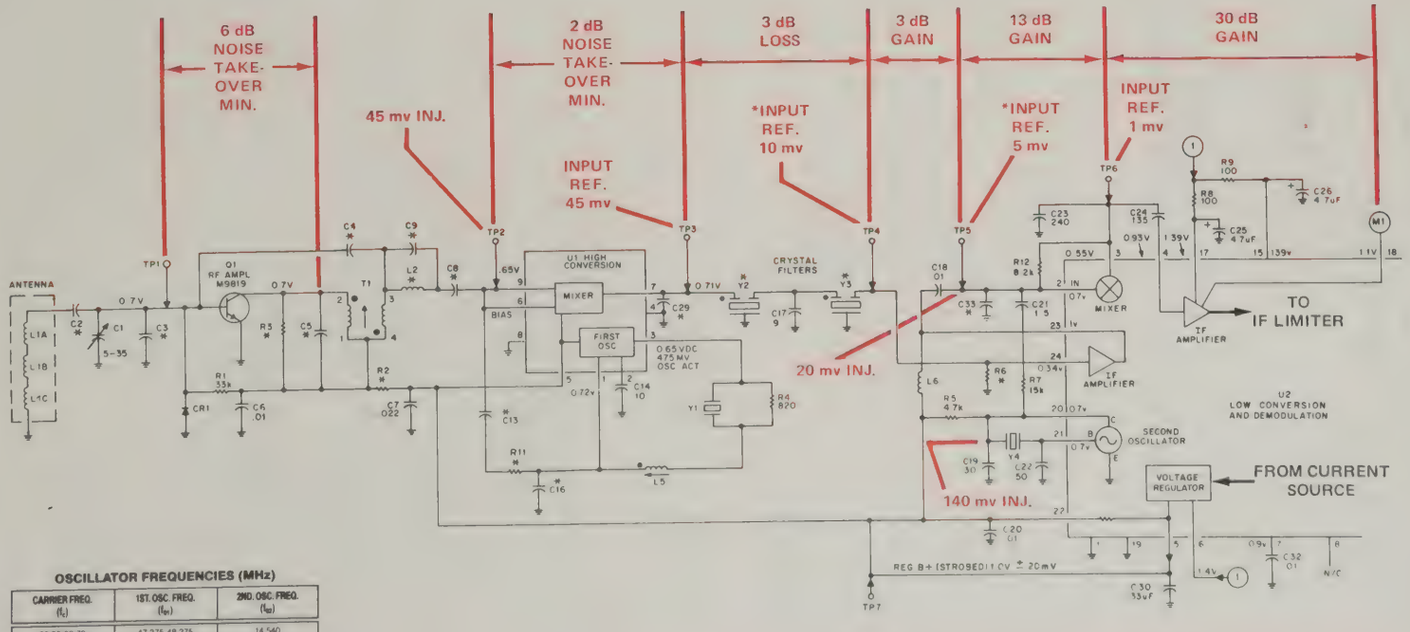


A01 SERIES TEST POINT LOCATOR



NOTE: The above layouts apply to circuit boards NRB2009B-1 through NRB2020B-1. For earlier version layouts, refer to Service Manual 68P81032C40-B.

"BPR 2000" DISPLAY A01 SERIES RECEIVER SCHEMATIC



OSCILLATOR FREQUENCIES (MHz)

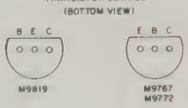
CARRIER FREQ. (f_c)	1ST. OSC. FREQ. (f_{lo})	2ND. OSC. FREQ. (f_{lo})
33.00-33.70	47.375-48.075	14.540
33.70-34.00	48.275-48.575	14.610
34.00-34.70	48.575-49.275	14.540
34.70-35.00	49.275-49.575	14.810
35.00-36.20	49.575-50.775	14.540
36.20-36.40	50.775-50.975	14.610
36.40-37.00	50.975-51.575	14.540
40.06-40.20	57.900-58.100	17.935
40.20-41.50	58.100-59.400	17.865
41.50-41.80	59.400-59.700	17.935
41.80-42.70	59.700-60.600	17.865
42.70-43.00	60.600-60.900	17.935
43.00-44.40	60.900-62.300	17.865
44.40-44.70	62.300-62.600	17.935
44.70-46.30	62.600-64.200	17.865
46.30-46.50	64.200-64.400	17.935
46.50-47.40	64.400-65.300	17.865
47.40-47.70	65.300-65.600	17.935
47.70-48.90	65.600-66.800	17.865
48.90-49.20	66.800-67.100	17.935
49.20-49.80	67.100-67.700	17.865
49.80-50.00	67.700-67.900	17.935

33-37MHz CARRIER FREQUENCY RANGE:
$f_c = f_{lo} - 14.575MHz$

40-50MHz CARRIER FREQUENCY RANGE:
$f_c = f_{lo} - 17.900MHz$

*DISABLE SECOND OSCILLATOR (GROUND PIN 20 OF U2) WHEN SETTING THE REFERENCE AT TP5 OR CHECKING THE GAIN FROM TP4 TO TP5.

TRANSISTOR DETAILS
(BOTTOM VIEW)



CIRCUIT BOARD AND SCHEMATIC DIAGRAM NOTES

1. *FREQUENCY SENSITIVE. REFER TO ELECTRICAL PARTS LIST FOR VALUE.
2. UNLESS OTHERWISE NOTED
   a. CAPACITOR VALUES ONE OR GREATER ARE IN PICOFARADS. CAPACITOR VALUES LESS THAN ONE ARE IN MICROFARADS.
   b. ALL RESISTOR VALUES ARE IN OHMS (K = 1000).

PAGER SPECIFICATIONS

Radiated Paging Sensitivity	10 uv
Radiated 10 dB Rise	40 uv

"BPR 2000" DISPLAY PAGER

A01 SERIES

SERVICE AIDS

Universal Radiation Fixture	RTL-1005A
50 Ohm Termination*	TEKA-99
IF Metering Flap*	RTL-4062A
Bracket and Clamp*	1V80304A65
6 dB 50 Ohm Pad	58-80322A17
Code Plug Removal/ Disassembly Tool	66-05799H01
Alignment/Troubleshooting Housing	RTL-4107A
Alignment Tool	66-80329A63
Portable Electrostatic Protection Kit	RSX-4014B

*Included with the RTL-1005A.

TROUBLESHOOTING PROCEDURE — PRELIMINARY CHECKS

1. Prior to starting any pager performance checks or troubleshooting procedures, the pager's battery voltage must be checked. Battery voltage should read greater than 1.1 VDC. This check should be made with the alert tone sounding (turn pager from OFF to ON) in order to provide a load to the battery.

   With a good battery installed in the pager, perform the radiated paging sensitivity check. The threshold sensitivity of the paging circuitry can be found by reducing the RF signal level to a point that enables the alert tone on three consecutive applications of the pager code to the signal generator. This level should not exceed 10 microvolts.

   NOTE: Check paging sensitivity for all applicable paging codes, verifying the correct response to both tone only and tone and data paging messages.

2. If the pager fails the paging sensitivity check, perform the radiated 10 dB rise check to isolate the problem area to the receiver or decoder.

   It should take no more than 40 microvolts to obtain a 10 dB rise at IF test point (M1). If the pager passes the 10 dB rise check, go to the decoder troubleshooting procedure. If the pager drastically fails the 10 dB rise check (more than 100 microvolts), go to the receiver troubleshooting procedures. If the pager marginally fails the 10 dB rise check (less than 100 microvolts), try realigning the pager and perform the 10 dB rise check again. If little or no improvement is attained, go to the receiver troubleshooting procedure.

ALIGNMENT PROCEDURE

BASIC TUNING PROCEDURE

1. Assemble the pager chassis and control head with a fresh battery in the alignment housing and place the pager in the radiation test fixture.
2. Lower the metering pin flap and connect metering point M1 to an AC voltmeter.
3. Connect an RF signal generator to the RADIATION input of the test fixture. Modulate the carrier with a 400 Hz tone at 4 KHz deviation.
4. Apply sufficient carrier to the radiation input of the fixture to obtain a reading on the -30 dBm scale of the AC voltmeter.
5. Tune L5, T1 and C1 for peak deflection on the AC voltmeter. If necessary, adjust the output level of the signal generator to maintain the AC voltmeter reading on the -30 dBm scale.

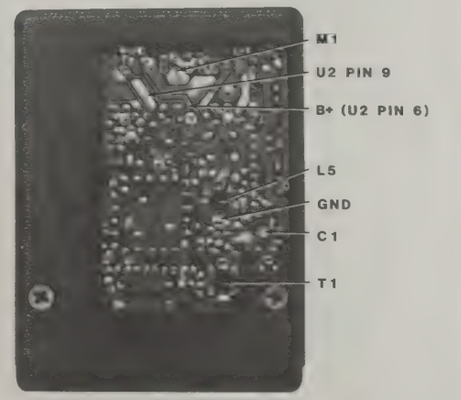
FREQUENCY ADJUSTMENT PROCEDURE

Preferred Method

1. Connect the amplifier output of the AC voltmeter to a frequency counter. Reduce signal generator output to minimum.
2. Radiate an "on frequency" source of 17.9 MHz (or 14.575 MHz) into the pager of sufficient level to produce at least a 15 dB rise at M1.
3. Count the second IF frequency on the frequency counter. Record this reading to within ± 10 Hz. It must read within ± 1.5 KHz of 35 KHz. Turn off the source of 17.9 MHz (or 14.575 MHz).
4. Apply an "on carrier" signal to the radiation input of the test fixture. Adjust the signal generator output so as to obtain the same reading at M1 as was observed in Step 2. Adjust pager warping coil L5 to a point that produces the same second IF frequency (± 100 Hz) as recorded in Step 3.

Secondary Frequency Adjustment Procedures

1. Connect the amplifier output of the AC voltmeter to an oscilloscope. Set the oscilloscope sweep speed to 5 msec/div.
2. Simultaneously apply an "on carrier" signal to the radiation input of the test fixture and radiate into the pager a source of 17.9 MHz (or 14.575 MHz). Adjust the level of the two signals until what appears to be an amplitude modulated waveform is displayed on the oscilloscope.
3. While viewing the scope, adjust L5 for a zero beat indication or lowest possible amplitude modulating frequency.



NOTE: While performing the pager alignment procedure, it will be necessary to override the "Battery Saver" circuitry (if so equipped). This can be accomplished by connecting a 10K ohm resistor from U2 Pin 9 to B+.

"BPR 2000" DISPLAY A01 SERIES RECEIVER TROUBLESHOOTING PROCEDURE

1. First place the pager chassis and control head in the alignment/troubleshooting housing. Then place the entire assembly in the radiation test fixture. Do not lower the IF metering flap at this time.

   NOTE: In order to perform the following receiver checks, the battery saver (if so equipped) must be defeated. This can be accomplished by connecting a 10K ohm resistor from U2 Pin 9 to B+.

2. Using an RF millivoltmeter, check the first mixer injection voltage. TP2 should indicate approximately 45 mv. If the reading is found to be low or non-existent, check the regulated B+ (1 VDC) at TP7 and the DC voltages associated with the U1 module. If the previous tests prove negative, check Y1 and the discrete components associated with U1 before replacing U1.

3. Using the RF millivoltmeter, check the second mixer injection voltage. TP5 should indicate approximately 20 mv. If the reading is found to be low or non-existent, measure the oscillator activity at Pin 20 of U2. It should be approximately 140 mv. If this reading appears good, check R7 and C21. If the oscillator activity is low or non-existent, check all the DC voltages associated with the U2 module. If these voltages are good, check for a defective C19 or C22. If the previous tests prove negative, try substituting a new crystal before replacing U2.

4. READ CAREFULLY

   A. If the results of the 10 dB rise check indicated the receiver is capable of passing a signal (signal level increase observed at M1), proceed to Step 5.

   B. If the results of the 10 dB rise check indicated a totally inoperative receiver (no signal level increase observed at M1), proceed as follows:

      Lower the IF metering flap assembly and radiate 17.9 MHz (or 14.575 MHz) into the pager and note any rise at M1. If good rise is noted, proceed to Step 7. If no rise is noted, perform Step 5.

5. Using an AC voltmeter, check the gain between TP6 and M1. With the IF metering flap lowered, move the metering pin from M1 to TP6. Now apply "on-carrier" signal to the input of the radiation test fixture and increase the generator's output until a reading of 1 mv (-57.8 dBm) is obtained at TP6. With the reference level established, move the metering pin back to M1 and a gain of approximately 30 dB should be noted. A gain of 20 dB or less indicates a faulty U2 module.

   If the reference level CANNOT be set or a proper gain measurement is indicated, proceed to Step 6.

6. Using the RF millivoltmeter, check the conversion gain of the second mixer (TP5 to TP6). First disable the second oscillator by shorting Pin 20 of U2 to ground. Now apply sufficient carrier to the test fixture's input to establish a 5 mv (-33 dB) reference at TP5. Once the reference is established, remove the short from Pin 20 of U2 and move the RF probe to TP6. A gain of approximately 13 dB should be noted. A gain measurement of 6 dB or less indicates a possible defective U2 module. If the reference level CANNOT be set or a correct gain measurement is indicated, proceed to Step 7.

7. With the RF millivoltmeter, check the gain from TP4 to TP5. With the second oscillator shorted out (Pin 20 of U2 to ground), apply sufficient carrier to the radiated input of the fixture to obtain a reading of 10 mv (-27 dBm) at TP4. With the reference established, move the RF probe to TP5. A gain of approximately 3 dB should be noted. If the gain is low, the U2 module is suspect. If the reference level CANNOT be set or the gain is acceptable, proceed to Step 8.

8. Using the RF millivoltmeter, check the insertion loss of Y2 and Y3.

   NOTE: The pager must be on frequency in order to properly check the crystal filters.

   Apply sufficient carrier to the radiated input to obtain a reading of 45 mv (-14 dBm) at TP3. If the reference can be established, move the RF probe to TP4. The insertion loss of crystal pair should be approximately 3 dB. If the loss is high, check C17 before replacing the crystal filters.

   NOTE: Y2 and Y3 must be replaced as a matched set. If the reference level CANNOT be set or if the insertion loss is at an acceptable level, proceed to Step 9.

9. With no signal applied, perform the first mixer noise takeover. With the IF metering flap lowered, record the M1 idle noise level. Then using the tip of a tuning tool, short TP2 to ground. A drop of approximately 17 dB should be noted. If a drop of at least 2 dB is noted, proceed to Step 10. If a low (less than 2 dB) or no drop is indicated, the U1 module is suspect.

10. With no signal applied, perform the RF amplifier noise takeover check. With the IF metering flap lowered, record the idle noise at M1. Now short TP1 to ground. A drop of approximately 14 dB should be noted. If a drop of at least 6 dB is noted, check the antenna circuitry. If the drop is LOW (less than 6 dB) or NON-EXISTENT, check the DC voltages associated with Q1. A HIGHER than normal drop in noise may indicate regeneration around Q1. In this case, check components C4 and Q1.

    A final note - When replacing a defective Q1, always check protection diode CR1.

ALIGNMENT PROCEDURE

BASIC TUNING PROCEDURE

1. Assemble the pager chassis and control head with a fresh battery in the alignment housing and place the pager in the radiation test fixture.
2. Lower the metering pin flap and connect metering point M1 to an AC voltmeter.
3. Connect an RF signal generator to the RADIATION input of the test fixture. Modulate the carrier with a 400 Hz tone at 4 KHz deviation.
4. Apply sufficient carrier to the radiation input of the fixture to obtain a reading on the -30 dBm scale of the AC voltmeter.
5. Tune L5, T1 and C1 for peak deflection on the AC voltmeter. If necessary, adjust the output level of the signal generator to maintain the AC voltmeter reading on the -30 dBm scale.

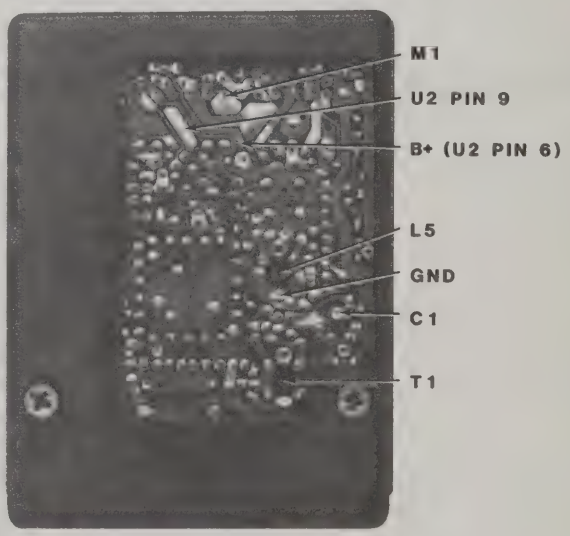
FREQUENCY ADJUSTMENT PROCEDURE

Preferred Method

1. Connect the amplifier output of the AC voltmeter to a frequency counter. Reduce signal generator output to minimum.
2. Radiate an "on frequency" source of 17.9 MHz (or 14.575 MHz) into the pager of sufficient level to produce at least a 15 dB rise at M1.
3. Count the second IF frequency on the frequency counter. Record this reading to within ± 10 Hz. It must read within ± 1.5 KHz of 35 KHz. Turn off the source of 17.9 MHz (or 14.575 MHz).
4. Apply an "on carrier" signal to the radiation input of the test fixture. Adjust the signal generator output so as to obtain the same reading at M1 as was observed in Step 2. Adjust pager warping coil L5 to a point that produces the same second IF frequency (± 100 Hz) as recorded in Step 3.

Secondary Frequency Adjustment Procedures

1. Connect the amplifier output of the AC voltmeter to an oscilloscope. Set the oscilloscope sweep speed to 5 msec/div.
2. Simultaneously apply an "on carrier" signal to the radiation input of the test fixture and radiate into the pager a source of 17.9 MHz (or 14.575 MHz). Adjust the level of the two signals until what appears to be an amplitude modulated waveform is displayed on the oscilloscope.
3. While viewing the scope, adjust L5 for a zero beat indication or lowest possible amplitude modulating frequency.



NOTE: While performing the pager alignment procedure, it will be necessary to override the "Battery Saver" circuitry (if so equipped). This can be accomplished by connecting a 10K ohm resistor from U2 Pin 9 to B+.

"BPR 2000" DISPLAY A01 SERIES RECEIVER TROUBLESHOOTING PROCEDURE

1. First place the pager chassis and control head in the alignment/troubleshooting housing. Then place the entire assembly in the radiation test fixture. Do not lower the IF metering flap at this time.

   NOTE: In order to perform the following receiver checks, the battery saver (if so equipped) must be defeated. This can be accomplished by connecting a 10K ohm resistor from U2 Pin 9 to B+.

2. Using an RF millivoltmeter, check the first mixer injection voltage. TP2 should indicate approximately 45 mv. If the reading is found to be low or non-existent, check the regulated B+ (1 VDC) at TP7 and the DC voltages associated with the U1 module. If the previous tests prove negative, check Y1 and the discrete components associated with U1 before replacing U1.

3. Using the RF millivoltmeter, check the second mixer injection voltage. TP5 should indicate approximately 20 mv. If the reading is found to be low or non-existent, measure the oscillator activity at Pin 20 of U2. It should be approximately 140 mv. If this reading appears good, check R7 and C21. If the oscillator activity is low or non-existent, check all the DC voltages associated with the U2 module. If these voltages are good, check for a defective C19 or C22. If the previous tests prove negative, try substituting a new crystal before replacing U2.

4. READ CAREFULLY

   A. If the results of the 10 dB rise check indicated the receiver is capable of passing a signal (signal level increase observed at M1), proceed to Step 5.

   B. If the results of the 10 dB rise check indicated a totally inoperative receiver (no signal level increase observed at M1), proceed as follows:

      Lower the IF metering flap assembly and radiate 17.9 MHz (or 14.575 MHz) into the pager and note any rise at M1. If good rise is noted, proceed to Step 7. If no rise is noted, perform Step 5.

5. Using an AC voltmeter, check the gain between TP6 and M1. With the IF metering flap lowered, move the metering pin from M1 to TP6. Now apply "on-carrier" signal to the input of the radiation test fixture and increase the generator's output until a reading of 1 mv (-57.8 dBm) is obtained at TP6. With the reference level established, move the metering pin back to M1 and a gain of approximately 30 dB should be noted. A gain of 20 dB or less indicates a faulty U2 module.

   If the reference level CANNOT be set or a proper gain measurement is indicated, proceed to Step 6.

6. Using the RF millivoltmeter, check the conversion gain of the second mixer (TP5 to TP6). First disable the second oscillator by shorting Pin 20 of U2 to ground. Now apply sufficient carrier to the test fixture's input to establish a 5 mv (-33 dB) reference at TP5. Once the reference is established, remove the short from Pin 20 of U2 and move the RF probe to TP6. A gain of approximately 13 dB should be noted. A gain measurement of 6 dB or less indicates a possible defective U2 module. If the reference level CANNOT be set or a correct gain measurement is indicated, proceed to Step 7.

7. With the RF millivoltmeter, check the gain from TP4 to TP5. With the second oscillator shorted out (Pin 20 of U2 to ground), apply sufficient carrier to the radiated input of the fixture to obtain a reading of 10 mv (-27 dBm) at TP4. With the reference established, move the RF probe to TP5. A gain of approximately 3 dB should be noted. If the gain is low, the U2 module is suspect. If the reference level CANNOT be set or the gain is acceptable, proceed to Step 8.

8. Using the RF millivoltmeter, check the insertion loss of Y2 and Y3.

   NOTE: The pager must be on frequency in order to properly check the crystal filters.

   Apply sufficient carrier to the radiated input to obtain a reading of 45 mv (-14 dBm) at TP3. If the reference can be established, move the RF probe to TP4. The insertion loss of crystal pair should be approximately 3 dB. If the loss is high, check C17 before replacing the crystal filters.

   NOTE: Y2 and Y3 must be replaced as a matched set. If the reference level CANNOT be set or if the insertion loss is at an acceptable level, proceed to Step 9.

9. With no signal applied, perform the first mixer noise takeover. With the IF metering flap lowered, record the M1 idle noise level. Then using the tip of a tuning tool, short TP2 to ground. A drop of approximately 17 dB should be noted. If a drop of at least 2 dB is noted, proceed to Step 10. If a low (less than 2 dB) or no drop is indicated, the U1 module is suspect.

10. With no signal applied, perform the RF amplifier noise takeover check. With the IF metering flap lowered, record the idle noise at M1. Now short TP1 to ground. A drop of approximately 14 dB should be noted. If a drop of at least 6 dB is noted, check the antenna circuitry. If the drop is LOW (less than 6 dB) or NON-EXISTENT, check the DC voltages associated with Q1. A HIGHER than normal drop in noise may indicate regeneration around Q1. In this case, check components C4 and Q1.

    A final note - When replacing a defective Q1, always check protection diode CR1.

PAGER SPECIFICATIONS

Radiated Paging Sensitivity	10 uv
Radiated 10 dB Rise	40 uv

"BPR 2000" DISPLAY PAGER

A03 SERIES

SERVICE AIDS

Universal Radiation Fixture	RTL-1005A
50 Ohm Termination*	TEKA-99
IF Metering Flap*	RTL-4062A
Bracket and Clamp*	1V80304A65
6 dB 50 Ohm Pad	58-80322A17
Code Plug Removal/ Disassembly Tool	66-05799H01
Alignment/Troubleshooting Housing	RTL-4107A
Alignment Tool	66-80329A63
Portable Electrostatic Protection Kit	RSX-4014B

*Included with the RTL-1005A.

TROUBLESHOOTING PROCEDURE – PRELIMINARY CHECKS

1. Prior to starting any pager performance checks or troubleshooting procedures, the pager's battery voltage must be checked. Battery voltage should read greater than 1.1 VDC. This check should be made with the alert tone sounding (turn pager from OFF to ON) in order to provide a load to the battery.

   With a good battery installed in the pager, perform the radiated paging sensitivity check. The threshold sensitivity of the paging circuitry can be found by reducing the RF signal level to a point that enables the alert tone on three consecutive applications of the pager code to the signal generator. This level should not exceed 10 microvolts.

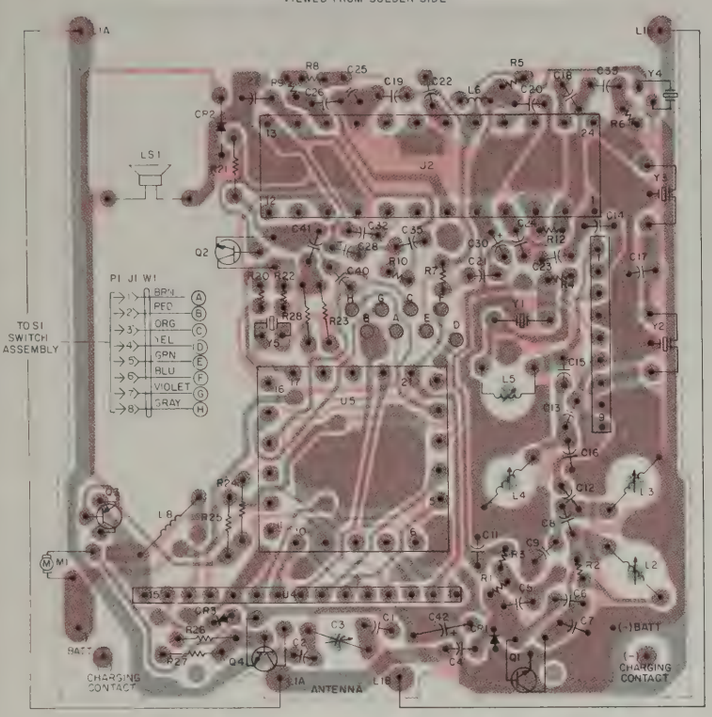
   NOTE: Check paging sensitivity for all applicable paging codes, verifying the correct response to both tone only and tone and data paging messages.

2. If the pager fails the paging sensitivity check, perform the radiated 10 dB rise check to isolate the problem area to the receiver or decoder.

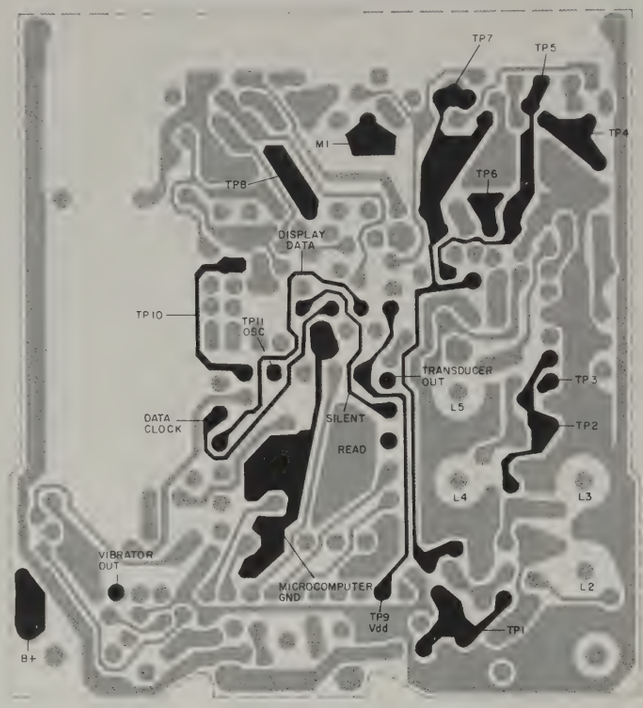
   It should take no more than 40 microvolts to obtain a 10 dB rise at IF test point (M1). If the pager passes the 10 dB rise check, go to the decoder troubleshooting procedure. If the pager drastically fails the 10 dB rise check (more than 100 microvolts), go to the receiver troubleshooting procedures. If the pager marginally fails the 10 dB rise check (less than 100 microvolts), try realigning the pager and perform the 10 dB rise check again. If little or no improvement is attained, go to the receiver troubleshooting procedure.

A03 SERIES COMPONENT LOCATOR

VIEWED FROM SOLDER SIDE

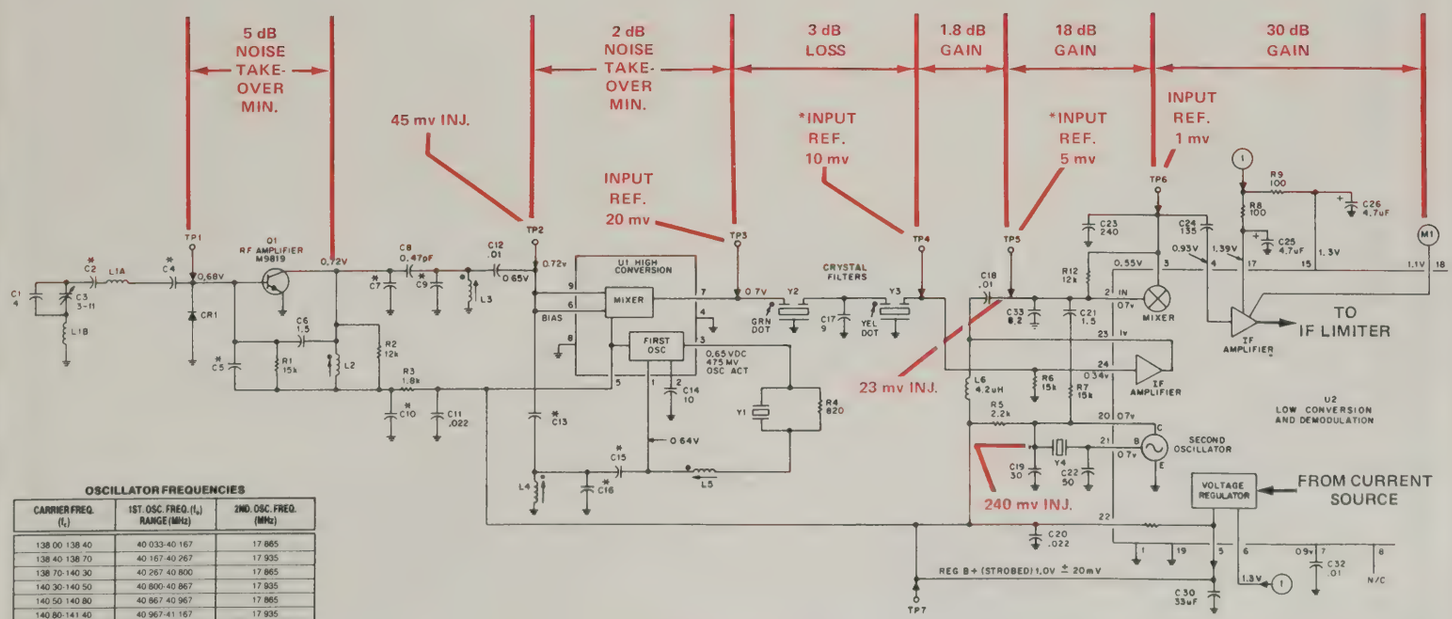


A03 SERIES TEST POINT LOCATOR



NOTE: The above layouts apply to circuit boards NRD2153B-3 through NRD2156B-3, NRD2163B-3 through NRD2166B-3, NRD2172B-2, NRD2173B-3 through NRD2176B-3, NRD2182B-2 and NRD2183B-3 through NRD2186B-3. For earlier version layouts, refer to Service Manual 68P81032C40-B.

"BPR 2000" DISPLAY A03 SERIES RECEIVER SCHEMATIC



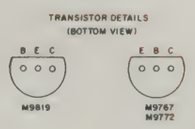
OSCILLATOR FREQUENCIES

CARRIER FREQ. (f_c)	1ST. OSC. FREQ. (f_o) RANGE (MHz)	2ND. OSC. FREQ. (MHz)
138.00-138.40	40.033-40.167	17.865
138.40-138.70	40.167-40.267	17.935
138.70-140.30	40.267-40.800	17.865
140.30-140.50	40.800-40.867	17.935
140.50-140.80	40.867-40.967	17.865
140.80-141.40	40.967-41.167	17.935
141.40-142.80	41.167-41.633	17.865
142.80-143.10	41.633-41.733	17.935
143.10-145.10	41.733-42.400	17.865
145.10-145.30	42.400-42.467	17.935
145.30-146.50	42.467-42.867	17.865
146.50-146.70	42.867-42.933	17.935
146.70-151.70	42.933-43.367	17.865
148.00-151.70	43.36-44.60	17.865
151.70-152.00	44.60-44.70	17.935
152.00-152.81	44.70-44.97	17.865
152.81-152.87	44.97-44.99	17.935
152.87-157.10	44.99-46.40	17.865
157.10-157.70	46.40-46.60	17.935
157.70-160.70	46.60-47.60	17.865
160.70-161.30	47.60-47.80	17.935
161.30-165.20	47.80-49.10	17.865
165.20-165.80	49.10-49.30	17.935
165.80-167.90	49.30-50.00	17.865
167.90-168.50	50.00-50.20	17.935
168.50-169.70	50.20-50.60	17.865
169.70-170.30	50.80-50.80	17.935
170.30-174.00	50.80-52.03	17.865

CARRIER FREQUENCY: $f_c = 3(f_o) + 17.9MHz$

*DISABLE SECOND OSCILLATOR (GROUND PIN 20 OF U2) WHEN SETTING THE REFERENCE AT TP5 OR CHECKING THE GAIN FROM TP4 TO TP5.

TRANSISTOR DETAILS (BOTTOM VIEW)



CIRCUIT BOARD AND SCHEMATIC DIAGRAM NOTES

1. *FREQUENCY SENSITIVE - REFER TO ELECTRICAL PARTS LIST FOR VALUE
2. UNLESS OTHERWISE NOTED
   a. CAPACITOR VALUES ONE OR GREATER ARE IN PICOFARADS. CAPACITOR VALUES LESS THAN ONE ARE IN MICROFARADS.
   b. ALL RESISTOR VALUES ARE IN OHMS (k = 1000)

PAGER SPECIFICATIONS

Radiated Paging Sensitivity	10 uv
Radiated 10 dB Rise	40 uv

"BPR 2000" DISPLAY PAGER

A03 SERIES

SERVICE AIDS

Universal Radiation Fixture	RTL-1005A
50 Ohm Termination*	TEKA-99
IF Metering Flap*	RTL-4062A
Bracket and Clamp*	1V80304A65
6 dB 50 Ohm Pad	58-80322A17
Code Plug Removal/ Disassembly Tool	66-05799H01
Alignment/Troubleshooting Housing	RTL-4107A
Alignment Tool	66-80329A63
Portable Electrostatic Protection Kit	RSX-4014B

*Included with the RTL-1005A.

TROUBLESHOOTING PROCEDURE – PRELIMINARY CHECKS

1. Prior to starting any pager performance checks or troubleshooting procedures, the pager's battery voltage must be checked. Battery voltage should read greater than 1.1 VDC. This check should be made with the alert tone sounding (turn pager from OFF to ON) in order to provide a load to the battery.

   With a good battery installed in the pager, perform the radiated paging sensitivity check. The threshold sensitivity of the paging circuitry can be found by reducing the RF signal level to a point that enables the alert tone on three consecutive applications of the pager code to the signal generator. This level should not exceed 10 microvolts.

   NOTE: Check paging sensitivity for all applicable paging codes, verifying the correct response to both tone only and tone and data paging messages.

2. If the pager fails the paging sensitivity check, perform the radiated 10 dB rise check to isolate the problem area to the receiver or decoder.

   It should take no more than 40 microvolts to obtain a 10 dB rise at IF test point (M1). If the pager passes the 10 dB rise check, go to the decoder troubleshooting procedure. If the pager drastically fails the 10 dB rise check (more than 100 microvolts), go to the receiver troubleshooting procedures. If the pager marginally fails the 10 dB rise check (less than 100 microvolts), try realigning the pager and perform the 10 dB rise check again. If little or no improvement is attained, go to the receiver troubleshooting procedure.

ALIGNMENT PROCEDURE

BASIC TUNING PROCEDURE

1. Assemble the pager chassis and control head with a fresh battery in the alignment housing and place the pager in the radiation test fixture.
2. Lower the metering pin flap and connect metering point M1 to an AC voltmeter.
3. Connect an RF signal generator to the RADIATION input of the test fixture. Modulate the carrier with a 400 Hz tone at 4 KHz deviation.
4. Apply sufficient carrier to the radiation input of the fixture to obtain a reading on the -40 dBm scale of the AC voltmeter.
5. Tune L5, L4, L3, L2 and C3 for peak deflection on the AC voltmeter. If necessary, adjust the output level of the signal generator to maintain the AC voltmeter reading on the -40 dBm scale.

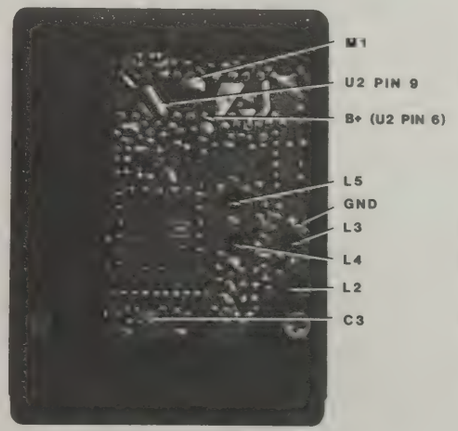
FREQUENCY ADJUSTMENT PROCEDURE

Preferred Method

1. Connect the amplifier output of the AC voltmeter to a frequency counter. Reduce signal generator output to minimum.
2. Radiate an "on frequency" source of 17.9 MHz into the pager of sufficient level to produce at least a 15 dB rise at M1.
3. Count the second IF frequency on the frequency counter. Record this reading to within ± 10 Hz. It must read within ± 1.5 KHz of 35 KHz. Turn off the source of 17.9 MHz.
4. Apply an "on carrier" signal to the radiation input of the test fixture. Adjust the signal generator output so as to obtain the same reading at M1 as was observed in Step 2. Adjust pager warping coil L5 to a point that produces the same second IF frequency (± 100 Hz) as recorded in Step 3.

Secondary Frequency Adjustment Procedures

1. Connect the amplifier output of the AC voltmeter to an oscilloscope. Set the oscilloscope sweep speed to 5 msec/div.
2. Simultaneously apply an "on carrier" signal to the radiation input of the test fixture and radiate into the pager a source of 17.9 MHz. Adjust the level of the two signals until what appears to be an amplitude modulated waveform is displayed on the oscilloscope.
3. While viewing the scope, adjust L5 for a zero beat indication or lowest possible amplitude modulating frequency.



NOTE: While performing the pager alignment procedure, it will be necessary to override the "Battery Saver" circuitry (if so equipped). This can be accomplished by connecting a 10K ohm resistor from U2 Pin 9 to B+.

"BPR 2000" DISPLAY A03 SERIES RECEIVER TROUBLESHOOTING PROCEDURE

1. First place the pager chassis and control head in the alignment/troubleshooting housing. Then place the entire assembly in the radiation test fixture. Do not lower the IF metering flap at this time.

   NOTE: In order to perform the following receiver checks, the battery saver (if so equipped) must be defeated. This can be accomplished by connecting a 10K ohm resistor from U2 Pin 9 to B+.

2. Using an RF millivoltmeter, check the first mixer injection voltage. TP2 should indicate approximately 45 mv. If the reading is found to be low or non-existent, check the regulated B+ (1 Vdc) at TP7 and the DC voltages associated with the first oscillator. If the previous tests prove negative, check Y1 and the discrete components associated with U1 before replacing U1.

3. Using the RF millivoltmeter, check the second mixer injection voltage. TP5 should indicate approximately 23 mv. If the reading is found to be low or non-existent, measure the oscillator activity at Pin 20 of U2. It should be approximately 240 mv. If this reading appears good, check R7 and C21. If the oscillator activity is low or non-existent, check all the DC voltages associated with the U2 module. If these voltages are good, check for a defective C19 or C22. If the previous tests prove negative, try substituting a new crystal before replacing U2.

4. READ CAREFULLY

   A. If the results of the 10 dB rise check indicated the receiver is capable of passing a signal (signal level increase observed at M1), proceed to Step 5.

   B. If the results of the 10 dB rise check indicated a totally inoperative receiver (no signal level increase observed at M1), proceed as follows:

      Lower the IF metering flap assembly and radiate 17.9 MHz into the pager and note any rise at M1. If good rise is noted, proceed to Step 7. If no rise is noted, perform Step 5.

5. Using an AC voltmeter, check the gain between TP6 and M1..

   With the metering flap lowered, move the metering pin from M1 to TP6. Now apply "on carrier" signal to the input of the radiation test fixture and increase the generator's output until a reading of 1 mv (-57.8 dBm) is obtained at TP6.

   With the reference level established, move the metering pin back to M1 and a gain of approximately 30 dB should be noted. A gain of 20 dB or less indicates a faulty U2 module. If the reference level CANNOT be set or a proper gain measurement is indicated, proceed to Step 6.

6. Using the RF millivoltmeter, check the conversion gain of the second mixer (TP5 to TP6).

   First disable the second oscillator by shorting Pin 20 of U2 to ground. Now apply sufficient carrier to the test fixture's input to establish a 5 mv (-33 dBm) reference at TP5. Once the reference is established, remove the short from Pin 20 of U2 and move the RF probe to TP6. A gain of approximately 18 dB should be noted. A gain measurement of 10 dB or less indicates a possible defective U2 module. If the reference level CANNOT be set or a correct gain measurement is indicated, proceed to Step 7.

7. With the RF millivoltmeter, check the gain from TP4 to TP5. With the second oscillator shorted out (Pin 20 of U2 to ground), apply sufficient carrier to the radiated input of the fixture to obtain a reading of 10 mv (-27 dBm) at TP4. With the reference established, move the RF probe to TP5. A gain of approximately 1 dB should be noted. If the gain is low, the U2 module is suspect. If the reference level CANNOT be set or the gain is acceptable, proceed to Step 8.

8. Using the RF millivoltmeter, check the insertion loss of Y2 and Y3.

   NOTE: The pager must be on frequency in order to properly check the crystal filters.

   Apply sufficient carrier to the radiated input to obtain a reading of 20 mv (-21 dBm) at TP3. If the reference can be established, move the RF probe to TP4. The insertion loss of crystal pair should be approximately 3 dB. If the loss is high, check C17 before replacing the crystal filters.

   NOTE: Y2 and Y3 must be replaced as a matched set. If the reference level CANNOT be set or if the insertion loss is at an acceptable level, proceed to Step 9.

9. With no signal applied, perform the first mixer noise takeover. With the IF metering flap lowered, record the M1 idle noise level. Then using the tip of a tuning tool, short TP2 to ground; a drop of approximately 12 dB should be noted. If a drop of at least 2 dB is noted, proceed to Step 10. If a LOW (less than 2 dB) or NO drop is indicated, the U1 module is suspect.

10. With no signal applied, perform the RF amplifier noise takeover check. With the IF metering flap lowered, record the idle noise at M1. Now short TP1 to ground. A drop of approximately 10 dB should be noted. If a drop of at least 5 dB is noted, check the antenna circuitry. If the drop is LOW (less than 5 dB) or NON-EXISTENT, check the DC voltages associated with Q1. A HIGHER than normal drop in noise may indicate regeneration around Q1. Check C5 and R1; if these components are good, replace Q1. A final note - When replacing a defective Q1, always check protection diode CR1.

PAGER SPECIFICATIONS

Radiated Paging Sensitivity	15 uv
Radiated 10 dB Rise	30 uv

"BPR 2000" DISPLAY PAGER

A04 SERIES

SERVICE AIDS

Universal Radiation Fixture	RTL-1005A
50 Ohm Termination*	TEKA-99
IF Metering Flap*	RTL-4062A
Bracket and Clamp*	1V80304A65
6 dB 50 Ohm Pad	58-80322A17
Code Plug Removal/ Disassembly Tool	66-05799H01
Alignment/Troubleshooting Housing	RTL-4107A
Alignment Tool	66-80329A63
Portable Electrostatic Protection Kit	RSX-4014B

*Included with the RTL-1005A.

TROUBLESHOOTING PROCEDURE – PRELIMINARY CHECKS

1. Prior to starting any pager performance checks or troubleshooting procedures, the pager's battery voltage must be checked. Battery voltage should read greater than 1.1 VDC. This check should be made with the alert tone sounding (turn pager from OFF to ON) in order to provide a load to the battery.

   With a good battery installed in the pager, perform the radiated paging sensitivity check. The threshold sensitivity of the paging circuitry can be found by reducing the RF signal level to a point that enables the alert tone on three consecutive applications of the pager code to the signal generator. This level should not exceed 15 microvolts.

   NOTE: Check paging sensitivity for all applicable paging codes, verifying the correct response to both tone only and tone and data paging messages.

2. If the pager fails the paging sensitivity check, perform the radiated 10 dB rise check to isolate the problem area to the receiver or decoder.

   It should take no more than 30 microvolts to obtain a 10 dB rise at IF test point (M1). If the pager passes the 10 dB rise check, go to the decoder troubleshooting procedure. If the pager drastically fails the 10 dB rise check (more than 100 microvolts), go to the receiver troubleshooting procedures. If the pager marginally fails the 10 dB rise check (less than 100 microvolts), try realigning the pager and perform the 10 dB rise check again. If little or no improvement is attained, go to the receiver troubleshooting procedure.

PAGER SPECIFICATIONS

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Radiated 10 dB Rise	30 uv

"BPR 2000" DISPLAY PAGER

A04 SERIES

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ALIGNMENT PROCEDURE

1. Assemble the pager chassis and control head with a fresh battery in the alignment housing and place the pager in the radiation test fixture. Then lower the metering pin flap and connect metering point M1 to an AC voltmeter.

2. Before beginning the tuning procedure, preset the following adjustments:
   a. Adjust L2 so that slug is flush with the bottom of the coil.
   b. Adjust L3 and L4 so that slug is flush with the solder side of the PC board.
   c. Adjust C13 so the dot is pointing toward the battery housing.

NOTE: Set the pager to the carrier frequency by following the preferred or secondary frequency adjustment procedure.

FREQUENCY ADJUSTMENT PROCEDURE

Preferred Method

3. Connect the amplifier output of the AC voltmeter to a frequency counter.

4. Radiate an "on frequency" source of 17.9 MHz into the pager of sufficient level to produce at least a 15 dB rise at M1.

5. Count the second IF frequency on the frequency counter. Record this reading to within ± 10 Hz. It must read within ± 1.5 KHz of 35 KHz. Turn off the source of 17.9 MHz.

6. Apply an "on carrier" signal to the radiation input of the test fixture. Adjust the signal generator output so as to obtain the same reading at M1 as was observed in Step 4. Adjust the pager warping coil L5 to a point that produces the same second IF frequency (± 100 Hz) as recorded in Step 5.

TUNING PROCEDURE

7. With the RF signal generator connected to the radiation input of the test fixture, modulate the carrier with a 400 Hz tone at 4 KHz deviation.

8. Apply sufficient carrier to the radiation input of the fixture to obtain a reading on the -40 dBm scale of the AC voltmeter.

9. Tune C3, C13, L2, L3 and L4 for peak deflection on the AC voltmeter. If necessary, adjust the output level of the signal generator to maintain the AC voltmeter reading on the -40 dBm scale.

10. Repeat Step 9.

11. Repeat the Frequency Adjustment Procedure.

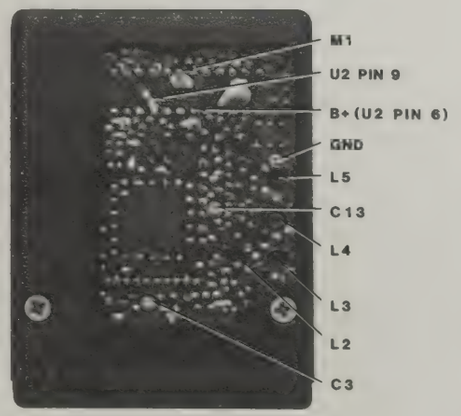
Secondary Frequency Adjustment Procedure

3. Connect the amplifier output of the AC voltmeter to an oscilloscope. Set the oscilloscope sweep speed to 5 msec/div.

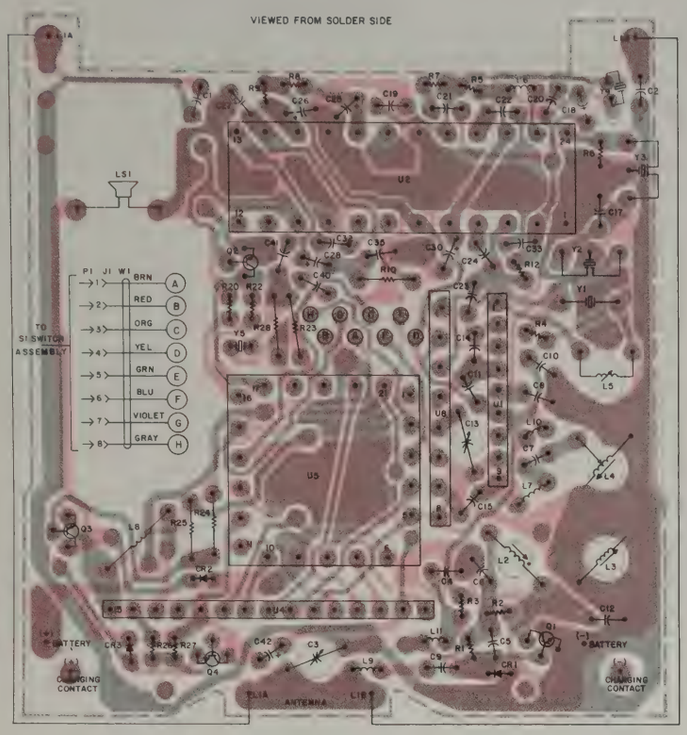
4. Simultaneously apply an "on carrier" signal to the radiation input of the test fixture and radiate into the pager a source of 17.9 MHz. Adjust the level of the two signals until what appears to be an amplitude modulated waveform is displayed on the oscilloscope.

5. While viewing the scope, adjust L5 for a zero beat indication or lowest possible amplitude modulating frequency.

NOTE: While performing the pager alignment procedure, it will be necessary to override the "Battery Saver" circuitry (if so equipped). This can be accomplished by connecting a 10K ohm resistor from U2 Pin 9 to B+.

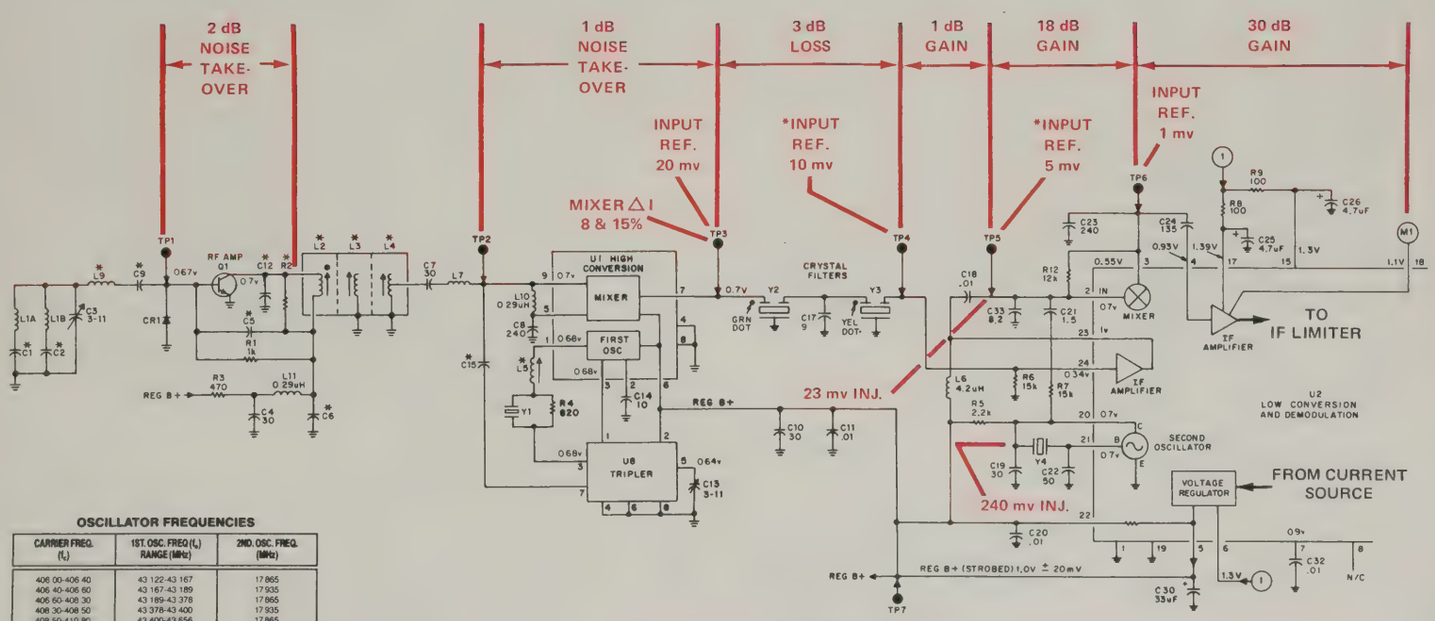


A04 SERIES COMPONENT LOCATOR



A04 SERIES TEST POINT LOCATOR

"BPR 2000" DISPLAY A04 SERIES RECEIVER SCHEMATIC



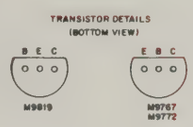
OSCILLATOR FREQUENCIES

CARRIER FREQ. (f_c)	1ST. OSC. FREQ. (f_o) RANGE (MHz)	2ND. OSC. FREQ. (MHz)
406.00-406.40	43.122-43.167	17.865
406.40-406.60	43.167-43.189	17.935
406.60-408.30	43.189-43.378	17.865
408.30-408.50	43.378-43.400	17.935
408.50-410.80	43.400-43.656	17.865
410.80-411.00	43.656-43.678	17.935
411.00-412.55	43.678-43.850	17.865
412.55-412.65	43.850-43.861	17.935
412.65-419.60	43.861-44.633	17.865
419.60-420.00	44.633-44.678	17.935
420.00-451.90	44.678-48.222	17.865
451.90-452.10	48.222-48.224	17.935
452.10-454.20	48.224-48.478	17.865
454.20-454.40	48.478-48.500	17.935
454.40-459.90	48.500-49.111	17.865
459.90-460.20	49.111-49.144	17.935
460.20-464.40	49.144-49.611	17.865
464.40-464.60	49.611-49.633	17.935
464.60-468.00	49.633-50.011	17.865
468.00-468.20	50.011-50.033	17.935
468.20-473.30	50.033-50.600	17.865
473.30-473.60	50.600-50.633	17.935
473.60-477.20	50.633-51.033	17.865
477.20-477.40	51.033-51.056	17.935
477.40-480.00	51.056-51.344	17.865
480.00-480.30	51.344-51.378	17.935
480.30-482.30	51.378-51.600	17.865
482.30-482.50	51.600-51.622	17.935
482.50-484.10	51.622-51.800	17.865
484.10-484.30	51.800-51.822	17.935
484.30-499.90	51.822-53.556	17.865
499.90-500.80	53.556-53.633	17.935
500.80-512.00	53.633-54.900	17.865

CARRIER FREQUENCY: $f_c = 8(f_o) + 17.86MHz$

*DISABLE SECOND OSCILLATOR (GROUND PIN 20 OF U2) WHEN SETTING THE REFERENCE AT TP5 OR CHECKING THE GAIN FROM TP4 TO TP5.

TRANSISTOR DETAILS (BOTTOM VIEW)



CIRCUIT BOARD AND SCHEMATIC DIAGRAM NOTES

1 *FREQUENCY SENSITIVE REFER TO ELECTRICAL PARTS LIST FOR VALUE
2 UNLESS OTHERWISE NOTED
a CAPACITOR VALUES ONE OR GREATER ARE IN PICOFARADS CAPACITOR VALUES LESS THAN ONE ARE IN MICROFARADS
b ALL RESISTOR VALUES ARE IN OHMS (k = 1000)

"BPR 2000" DISPLAY A04 SERIES RECEIVER TROUBLESHOOTING PROCEDURE

1. First place the pager chassis and control head in the alignment/troubleshooting housing. Then place the entire assembly in the radiation test fixture. Do not lower the IF metering flap at this time.

   NOTE: In order to perform the following receiver checks, the battery saver (if so equipped) must be defeated. This can be accomplished by connecting a 10K ohm resistor from U2 Pin 9 to B+.

2. The RF millivoltmeter used to measure mixer injection in VHF models offers too much capacitance at the UHF frequencies and could load down the front end RF stages, resulting in inaccurate readings. Therefore, a different test procedure (Mixer Δ I) is recommended for checking the first mixer/tripler circuit in UHF models.

   Mixer ΔI is a formulated percentage measurement that represents the amount of current change at the mixer's output (U1 Pin 7) when the first oscillator is on, then disabled. Mixer ΔI is defined by the following equation:

   $$\text{Mixer } \Delta I = \frac{\text{Voff - Von x 100\%}}{\text{1 - Voff}}$$

   where: Voff (dc) is the voltage at U1 Pin 7 with Y1 disabled (U8 Pin 3 grounded)

   Von (dc) is the voltage at U1 Pin 7 with Y1 enabled (U8 Pin 3 not grounded)

   The difference in voltage (Voff - Von) at U1 Pin 7 should be approximately 30 mv. With a properly functioning mixer/tripler circuit, Mixer ΔI should be between 8 and 15%.

   If Mixer ΔI is found to be low or non-existent, check the regulated B+ (1 Vdc) at TP7 and the DC voltages associated with the high conversion (U1) and tripler (U8) modules. If these voltages check good, check Y1 and the discrete components associated with these modules before replacing U1 or U8.

3. Using the RF millivoltmeter, check the second mixer injection voltage. TP5 should indicate approximately 23 mv. If the reading is found to be low or non-existent, measure the oscillator activity at Pin 20 of U2. It should be approximately 240 mv. If this reading checks good, check R7 and C21. If the oscillator activity is low or non-existent, check all the DC voltages associated with the U2 module. If these voltages check good, check for a defective C19 or C22. If the previous tests proved negative, try substituting a new crystal before replacing U2.

4. READ CAREFULLY

   A. If the results of the 10 dB rise check indicated the receiver is capable of passing a signal (signal level increase observed at M1), proceed to Step 5.

   B. If the results of the 10 dB rise check indicated a totally inoperative receiver (no signal level increase observed at M1), proceed as follows:

      Lower the IF metering flap assembly and radiate 17.9 MHz into the pager and note any rise at M1. If good rise is noted, proceed to Step 7. If no rise is noted, perform Step 5.

5. Using an AC voltmeter, check the gain between TP6 and M1. With the IF metering flap lowered, move the metering pin from M1 to TP6. Now apply "on carrier" signal to the input of the radiation test fixture and increase the generator's output until a reading of 1 mv (-57.8 dBm) is obtained at TP6. With the reference level established, move the metering pin back to M1 and a gain of approximately 30 dB should be noted. A gain of 20 dB or less indicates a possible faulty U2 module. If the reference level CANNOT be set or a proper gain measurement is indicated, proceed to Step 6.

6. Using the RF millivoltmeter, check the conversion gain of the second mixer (TP5 to TP6).

   First disable the second oscillator by shorting Pin 20 of U2 to ground. Now apply sufficient carrier to the test fixture's input to establish a 5 mv (-33 dBm) reference at TP5. Once the reference is established, remove the short from Pin 20 of U2 and move the RF probe to TP6. A gain of approximately 18 dB should be noted. A gain measurement of 10 dB or less indicates a possible defective U2 module. If the reference level CANNOT be set or a correct gain measurement is indicated, proceed to Step 7.

7. With the RF millivoltmeter, check the gain from TP4 to TP5. With the second oscillator shorted out (Pin 20 of U2 to ground), apply sufficient carrier to the radiated input of the fixture to obtain a reading of 10 mv (-27 dBm) at TP4. With the reference established, move the RF probe to TP5. A gain of approximately 1.8 dB should be noted. If this reading is low, the U2 module is suspect. If the reference level CANNOT be set or the gain is acceptable, proceed to Step 8.

8. Using the RF millivoltmeter, check the insertion loss of Y2 and Y3.

   NOTE: The pager must be on frequency in order to properly check the crystal filters.

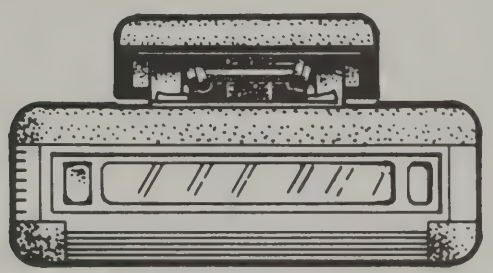
   Apply sufficient carrier to the radiated input to obtain a reading of 20 mv (-21 dBm) at TP3. If the reference can be established, move the RF probe to TP4. The insertion loss of the crystal pair should be approximately 3 dB; if not, check C17 before replacing the crystal filters.

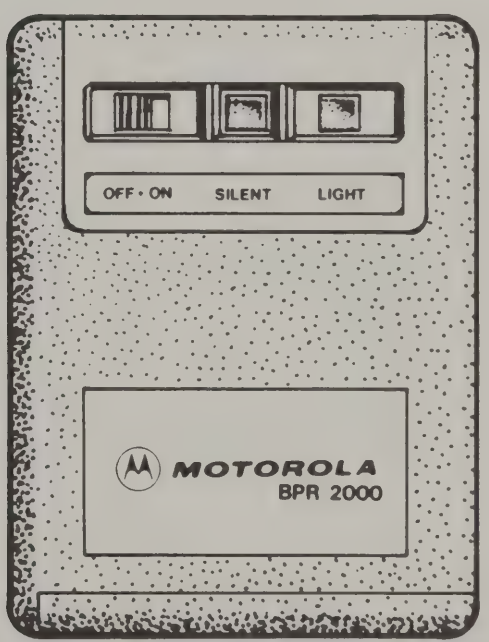
   NOTE: Y2 and Y3 must be replaced as a matched set. If the reference level CANNOT be set or if the insertion loss is at an acceptable level, proceed to Step 9.

9. With no signal applied, perform the first mixer noise takeover. With the IF metering flap lowered, record the M1 idle noise level. Then using the tip of a tuning tool, short TP2 to ground. If a drop of approximately 1 dB is noted, proceed to Step 10. If a low or no drop is indicated, the U1 module is suspect.

10. With no signal applied, perform the RF amplifier noise takeover check. With the IF metering flap lowered, record the idle noise level at M1. Now short TP1 to ground. If a drop of approximately 2 dB is noted, check the antenna circuitry. If the drop is low or non-existent, check the DC voltages associated with Q1 and the tuned circuit (L2, L3 and L4). A HIGHER than normal drop in noise may indicate regeneration around Q1. Check C5 and R1; if these components are good, replace Q1. A final note - When replacing a defective Q1, always check protection diode CR1.

DECODER TROUBLESHOOTING





"BPR 2000" DISPLAY A01, A03 AND A04 SERIES DECODER TROUBLESHOOTING PROCEDURE

1. Place the pager chassis and control head in the alignment/troubleshooting housing and place the entire assembly in the radiation test fixture. Do not lower the IF metering flap assembly.

2. Defeat the battery saver feature (if so equipped) by connecting a 10K ohm resistor from U2 Pin 9 to B+.

3. Apply an "on carrier" 1000 microvolt signal modulated with a 400 Hz tone at ± 4 KHz deviation, to the fixture's radiation input.

4. Now use a scope to check the recovered audio on Pin 14 of U2. Use scope waveform WF1 as a guide.
   Now, trace the recovered audio from Pin 14 of U2 through the shaping network to Pins 13 and 10, using waveforms WF2 and WF3 as guides.

   NOTE: Waveform at Pin 10 of U2 should have a 50/50 duty cycle (no worse than 40/60).

   If any signal is low in amplitude, distorted or non-existent, the U2 module is suspect. Before replacing the U2 module, check C27, C28, C35 and R10.

5. Check the output of the level shifter (TP10); use WF4 as a guide. Amplitude level should be at least 3 vp-p. If the signal is low in amplitude or non-existent, check discrete components Q2, R21 and R22.

6. Using a DC meter, check VDD (should be no less than 3.25 VDC) on Pin 21 of the U5 module. If the voltage is low or non-existent, check C42, U3, U5 and the control head for excessive loading.

   NOTE: Remove the chassis and control head from the alignment housing for the following checks, and attach the control head to the pager chassis. Use a piece of tape to secure the battery in place.

   If the previous tests prove negative, monitor with a scope Pin 13 of U4. Use WF5 as a guide. If the signal is absent or low in amplitude, check discrete components C43 (A01 series only) and L8. If these components check good, replace the U4 module.

7. Check the microcomputer's (U5) 1.536 MHz oscillator by monitoring TP11 with the scope. The signal should be a sinusoidal waveform at a frequency of 1.536 MHz ± 300 Hz, with an amplitude level of at least 2.3 vp-p (see WF6). If the signal is low, non-existent or the frequency is incorrect, check crystal Y5 and discrete components C40, C41, R23 and R28 before replacing U5.

8. Turn the pager from off to on. If the power-up alert is heard, proceed to Step 11. If not, proceed to Step 9.

9. Using a DC voltmeter, check Pin 20 of U5. In the standby mode, this voltage should be equal or greater than 2.8 VDC. Absence of this voltage indicates a faulty U4 module.

10. Now apply "on-carrier" 1000 microvolt signal modulated with the pager's code. Using a scope, trace the signal from Pin 1 of U5 to transducer LS1. Use WF7 and WF8 as guides. If an incorrect reading is indicated, check LS1 and the associated drive circuitry before replacing U5.

11. Using a DC voltmeter, measure the level at Pins 2 and 3 of the U5 module. The voltage level at these points should be at least 2.8 VDC. If these levels are low, refer to the Control Head Troubleshooting Procedure (Steps 2 and 3).

12. With a scope, monitor Pin 20 of the U5 module. A negative going pulse (Deadman Timer Reset) approximately every 80 msec indicates a loss of program control by the microcomputer. If the reset pulse is present, check (in the standby mode) function select lines A0-A3. Lines A0 and A1 should be at a logic low (0 VDC). Use WF9 as a guide when checking lines A2 and A3.
    An incorrect reading on any line indicates a defective U5 module. A correct reading on all lines indicates a faulty U4 module.

13. Read the contents of the code plug (U3), using the Digital Analyzer Controller. An incorrect reading indicates a faulty code plug. If the code plug tested good, module U5 is suspect.

14. Switch the pager from off to on. This time, observe the display. A series of 12 eights, tone symbol and source identifiers should be displayed. If the power-up display is produced, proceed to Step 16. If not, proceed to Step 15.

15. With a scope, check U5 Pins 14 and 15 for display data and data clock signals respectively. During the power-up sequence, Pin 14 should go high (2.8 VDC or greater) for approximately 2 seconds and on Pin 15, a series of clock pulses (see WF10) should be visible. If these lines check good, refer to the Control Head Troubleshooting Procedure (Steps 5 through 7). If they do not, replace the U5 module.

16. Enable the battery saver feature (if so equipped) and check TP8 with a scope. Use WF11 as a guide. If the battery saver strobe signal is low or non-existent, replace U5.

"VIBRA-PAGE" MODELS ONLY

17. Apply an "on-carrier" 1000 microvolt signal modulated with the pager's code. Using a DC voltmeter, check Pin 14 of U4 (vibrator out). The voltage level at this point should be approximately 1.4 VDC. If the level is low or missing, check for a faulty motor (M1) or defective drive circuitry before replacing the U4 module.

"BPR 2000" DISPLAY
A01, A03 AND A04 SERIES CONTROL HEAD TROUBLESHOOTING PROCEDURE

NOTE: For the following checks, the control head must be removed from the pager.

When disassembly and/or assembly of the control head is required, refer to the Theory/Maintenance Manual (Pages 14 and 15).

1. Turn ON/OFF switch (SIA) on and check for continuity between P1 Pins 1 and 4.
   If SIA reads open, replace switch assembly S1.

2. Depress read switch (S2) and check for continuity between P1 Pins 2 and 5.
   If S2 reads open, check for a bent, misaligned or broken edge connector (J2) or a misaligned popple switch before replacing switch assembly S1. Make a resistance check between P1 Pins 5 and 6 (470K ohms); an incorrect reading indicates a defective display module (U6).

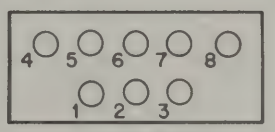
3. Depress silent switch (SIC) and check for continuity between P1 Pins 2 and 8.
   If SIC reads open, check for a misaligned popple switch before replacing switch assembly S1.
   Check the resistance between P1 Pins 6 and 8 (470K ohms); an incorrect reading indicates a faulty display module (U6).

4. Depress light switch (SIB) and check for continuity between P1 Pins 4 and 2.
   If SIB is open, check for a misaligned popple switch before replacing switch assembly S1.
   Check lamps DS1 and DS2.

5. Check continuity from P1 Pins 3 and 7 to the respective edge connector pins of J2.
   If an open connection is found, check for dirty or contaminated gold contacts before replacing the switch assembly S1.

6. Examine the LCD (U7) display for any breaks or cracks. If the display is found to be damaged, replace it.

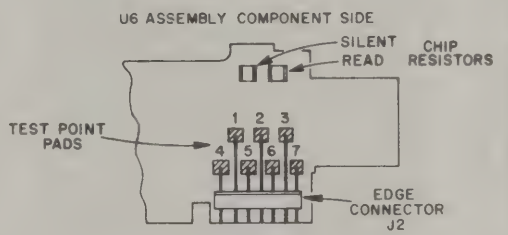
7. Carefully examine the conductive elastomers. If contaminated or damaged, replace them.
   Defective elastomers can cause poor contrast, missing segments, digits or indicators in display.



P1 PIN SIDE

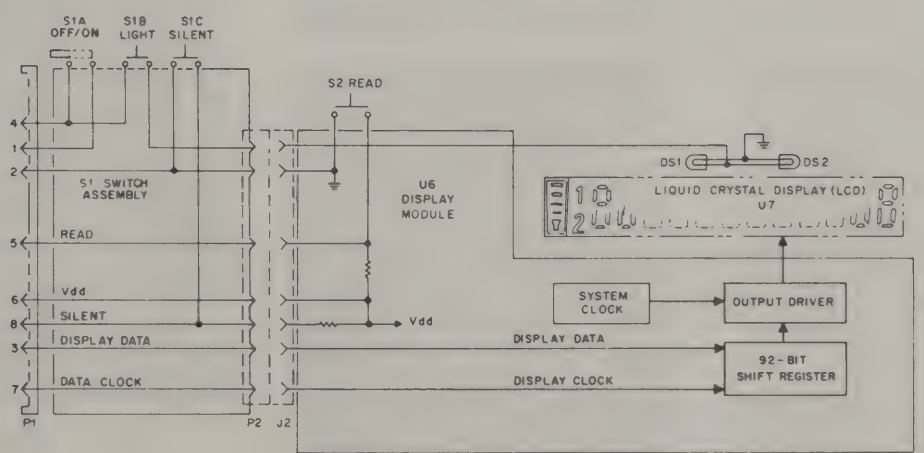
PIN NO	WIRE COLOR	SIGNAL
1	BROWN	ON/OFF SWITCH IN
2	RED	GROUND
3	ORANGE	DISPLAY DATA
4	YELLOW	ON/OFF SWITCH OUT
5	GREEN	READ
6	BLUE	Vdd
7	VIOLET	DATA CLOCK
8	GRAY	SILENT

CONNECTOR PLUG (P1)



PAD NO	SIGNAL
1	DISPLAY DATA
2	GROUND
3	Vdd
4	DATA CLOCK
5	SILENT
6	LAMP
7	READ

DISPLAY MODULE ASSEMBLY (U6) CONTROL HEAD



CONTROL HEAD SCHEMATIC

"BPR 2000" DISPLAY A01, A03 AND A04 SERIES DECODER TROUBLESHOOTING PROCEDURE

1. Place the pager chassis and control head in the alignment/troubleshooting housing and place the entire assembly in the radiation test fixture. Do not lower the IF metering flap assembly.

2. Defeat the battery saver feature (if so equipped) by connecting a 10K ohm resistor from U2 Pin 9 to B+.

3. Apply an "on carrier" 1000 microvolt signal modulated with a 400 Hz tone at ± 4 KHz deviation, to the fixture's radiation input.

4. Now use a scope to check the recovered audio on Pin 14 of U2. Use scope waveform WF1 as a guide.
   Now, trace the recovered audio from Pin 14 of U2 through the shaping network to Pins 13 and 10, using waveforms WF2 and WF3 as guides.

   NOTE: Waveform at Pin 10 of U2 should have a 50/50 duty cycle (no worse than 40/60).

   If any signal is low in amplitude, distorted or non-existent, the U2 module is suspect. Before replacing the U2 module, check C27, C28, C35 and R10.

5. Check the output of the level shifter (TP10); use WF4 as a guide. Amplitude level should be at least 3 vp-p. If the signal is low in amplitude or non-existent, check discrete components Q2, R21 and R22.

6. Using a DC meter, check VDD (should be no less than 3.25 VDC) on Pin 21 of the U5 module. If the voltage is low or non-existent, check C42, U3, U5 and the control head for excessive loading.

   NOTE: Remove the chassis and control head from the alignment housing for the following checks, and attach the control head to the pager chassis. Use a piece of tape to secure the battery in place.

   If the previous tests prove negative, monitor with a scope Pin 13 of U4. Use WF5 as a guide. If the signal is absent or low in amplitude, check discrete components C43 (A01 series only) and L8. If these components check good, replace the U4 module.

7. Check the microcomputer's (U5) 1.536 MHz oscillator by monitoring TP11 with the scope. The signal should be a sinusoidal waveform at a frequency of 1.536 MHz ± 300 Hz, with an amplitude level of at least 2.3 vp-p (see WF6). If the signal is low, non-existent or the frequency is incorrect, check crystal Y5 and discrete components C40, C41, R23 and R28 before replacing U5.

8. Turn the pager from off to on. If the power-up alert is heard, proceed to Step 11. If not, proceed to Step 9.

9. Using a DC voltmeter, check Pin 20 of U5. In the standby mode, this voltage should be equal or greater than 2.8 VDC. Absence of this voltage indicates a faulty U4 module.

10. Now apply "on-carrier" 1000 microvolt signal modulated with the pager's code. Using a scope, trace the signal from Pin 1 of U5 to transducer LS1. Use WF7 and WF8 as guides. If an incorrect reading is indicated, check LS1 and the associated drive circuitry before replacing U5.

11. Using a DC voltmeter, measure the level at Pins 2 and 3 of the U5 module. The voltage level at these points should be at least 2.8 VDC. If these levels are low, refer to the Control Head Troubleshooting Procedure (Steps 2 and 3).

12. With a scope, monitor Pin 20 of the U5 module. A negative going pulse (Deadman Timer Reset) approximately every 80 msec indicates a loss of program control by the microcomputer. If the reset pulse is present, check (in the standby mode) function select lines A0-A3. Lines A0 and A1 should be at a logic low (0 VDC). Use WF9 as a guide when checking lines A2 and A3.
    An incorrect reading on any line indicates a defective U5 module. A correct reading on all lines indicates a faulty U4 module.

13. Read the contents of the code plug (U3), using the Digital Analyzer Controller. An incorrect reading indicates a faulty code plug. If the code plug tested good, module U5 is suspect.

14. Switch the pager from off to on. This time, observe the display. A series of 12 eights, tone symbol and source identifiers should be displayed. If the power-up display is produced, proceed to Step 16. If not, proceed to Step 15.

15. With a scope, check U5 Pins 14 and 15 for display data and data clock signals respectively. During the power-up sequence, Pin 14 should go high (2.8 VDC or greater) for approximately 2 seconds and on Pin 15, a series of clock pulses (see WF10) should be visible. If these lines check good, refer to the Control Head Troubleshooting Procedure (Steps 5 through 7). If they do not, replace the U5 module.

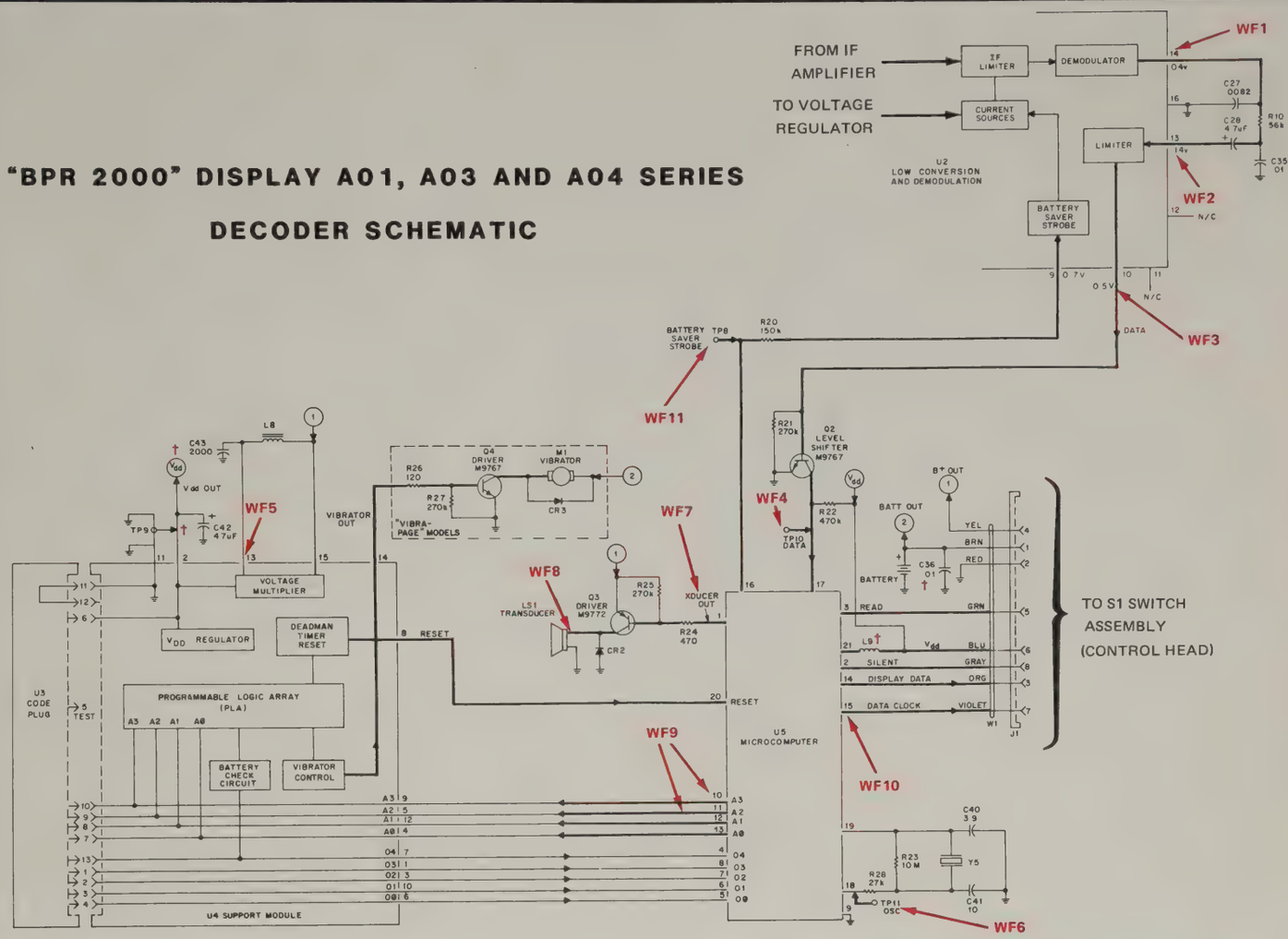
16. Enable the battery saver feature (if so equipped) and check TP8 with a scope. Use WF11 as a guide. If the battery saver strobe signal is low or non-existent, replace U5.

"VIBRA-PAGE" MODELS ONLY

17. Apply an "on-carrier" 1000 microvolt signal modulated with the pager's code. Using a DC voltmeter, check Pin 14 of U4 (vibrator out). The voltage level at this point should be approximately 1.4 VDC. If the level is low or missing, check for a faulty motor (M1) or defective drive circuitry before replacing the U4 module.

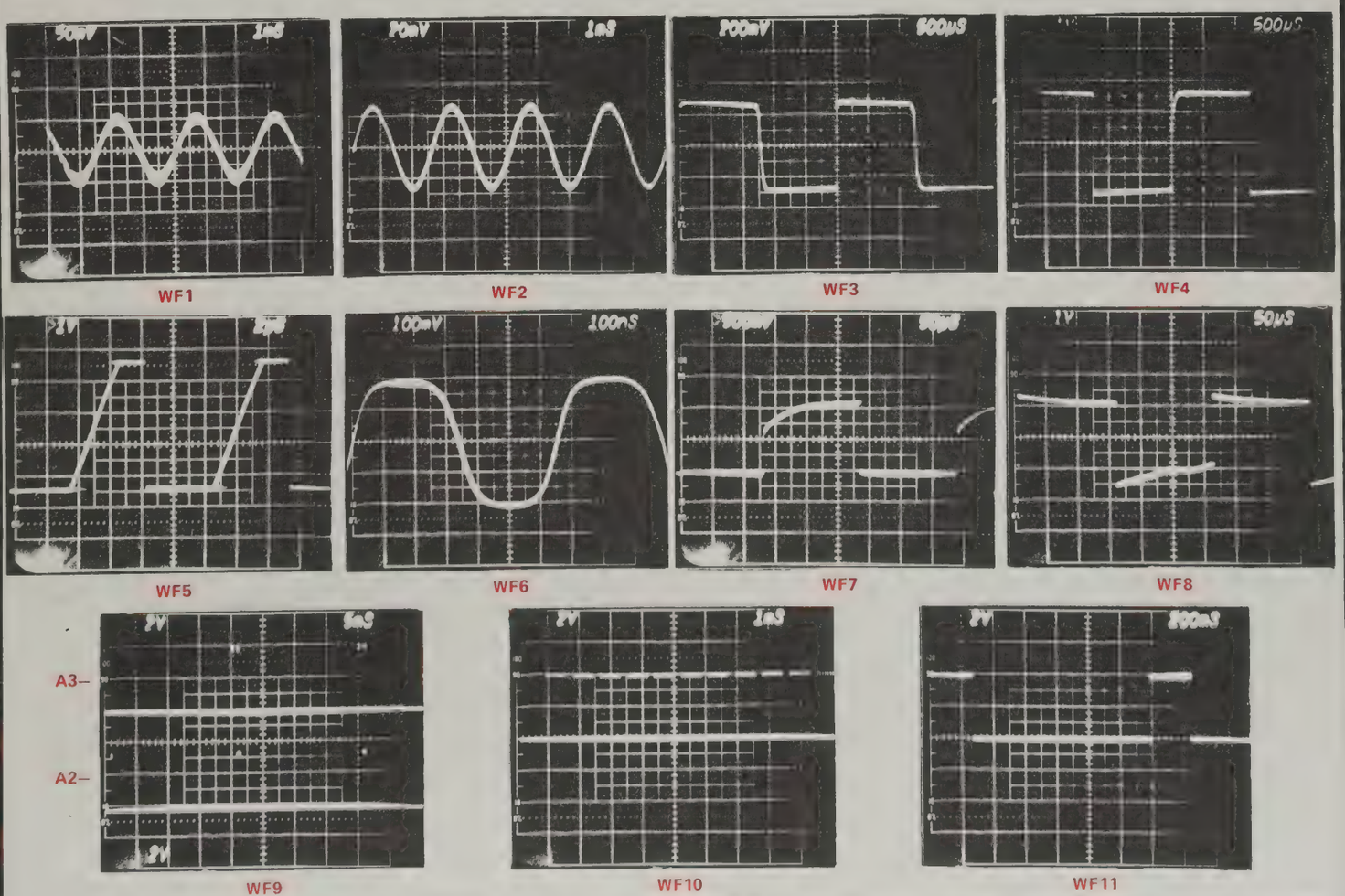
"BPR 2000" DISPLAY A01, A03 AND A04 SERIES

DECODER SCHEMATIC



†L9, C36 and C43 are used only in the A01 series decoder.
C42 is 10 uf in A03 and A04 series decoders.

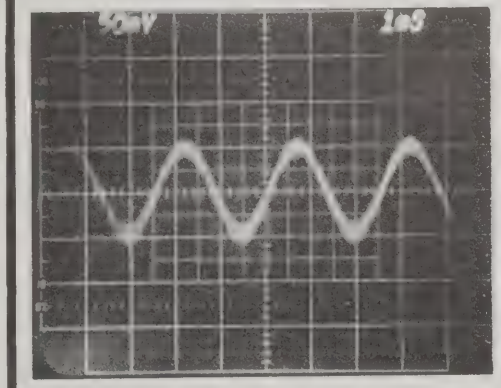
DECODER WAVEFORMS



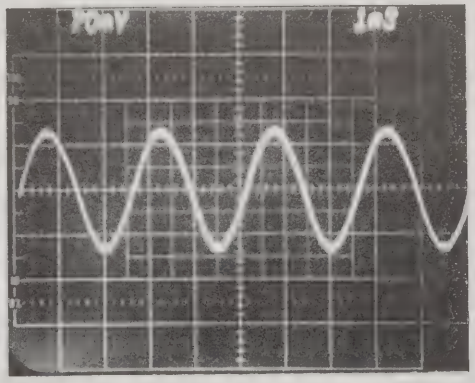
DEAR READER:

DUE TO EXPOSURE AND PRINTING PROBLEMS, SOME OF THE OSCILLOSCOPE DEFLECTION SETTINGS ON THE WAVEFORM PHOTOS FOUND ON PAGE 25 FOLD OUT, MAY NOT BE READABLE. PLEASE USE THE SETTINGS FOUND ON THE BACK OF THIS ADDENDUM PAGE TO VERIFY THE CORRECT DEFLECTION SETTINGS.

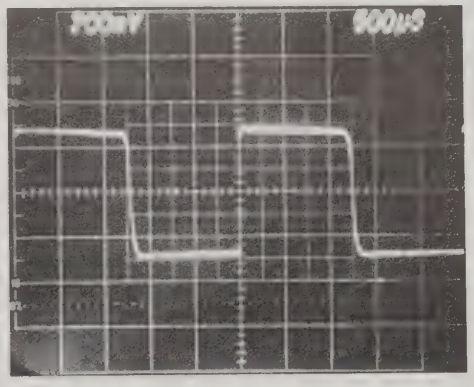
DECODER WAVEFORMS



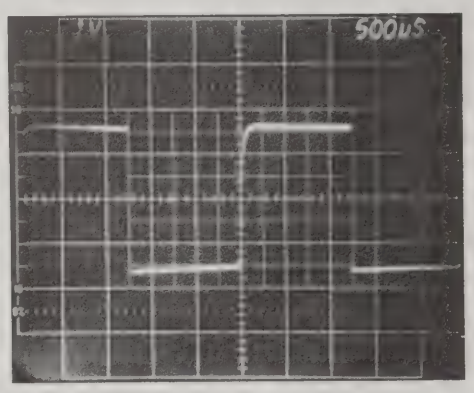
50mV/DIV. WF1 1mS/DIV.



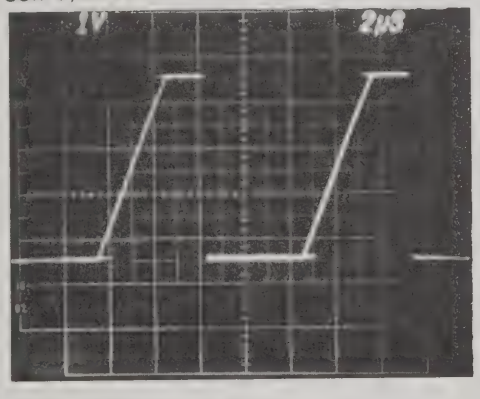
20mV/DIV. WF2 1mS/DIV.



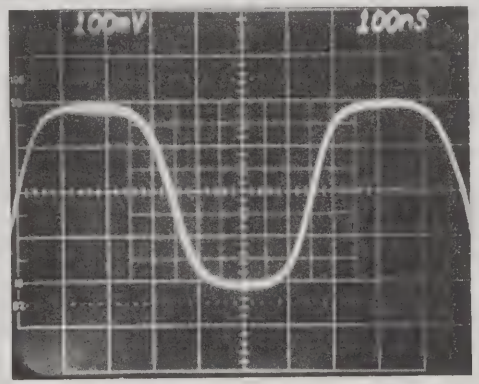
200mV/DIV. WF3 500uS/DIV.



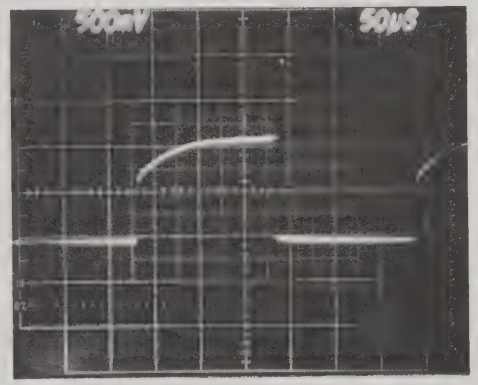
1V/DIV. WF4 500uS/DIV.



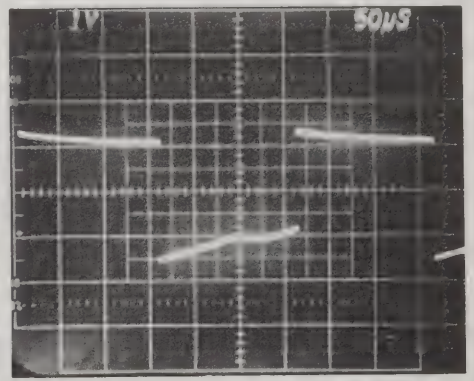
1V/DIV. WF5 2uS/DIV.



100mV/DIV. WF6 100nS/DIV.



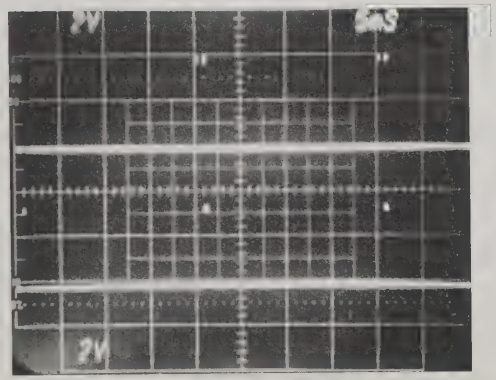
500mV/DIV. WF7 50uS/DIV.



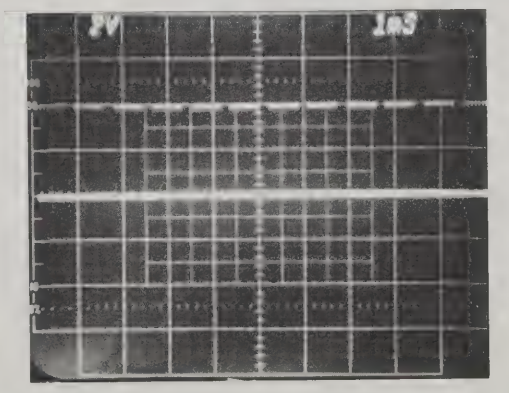
1V/DIV. WF8 50uS/DIV.

A3–

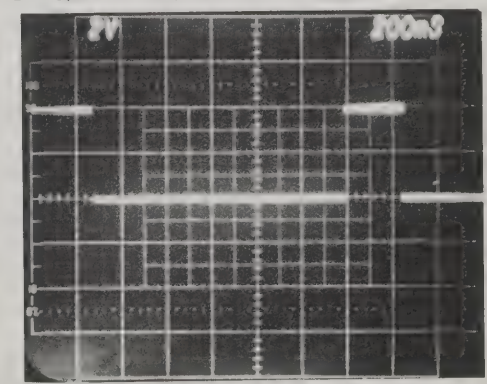
A2–



2V/DIV. WF9 5mS/DIV.



2V/DIV. WF10 1mS/DIV.



2V/DIV. WF11 200mS/DIV.

VI. ELECTROSTATIC DISCHARGE PROTECTION

Many of the integrated circuit (IC) devices used in communications equipment are of the CMOS (Complementary Metal Oxide Semiconductor) type. Because of their high open circuit impedance, CMOS IC's are vulnerable to damage from electrostatic discharges. The adage that only CMOS devices are prone to static discharge damage is no longer true. Tests have shown that ALL semiconductors (including chip and thin-film resistors) are susceptible to static discharge damage. Other tests have shown that these components are just as susceptible to static damage when they are installed in circuits as when they are removed. These test results point out two major areas of concern to field service operations: 1) Service Shop work stations; and 2) Inventory and receiving areas.

In unprotected work areas, a static discharge potential as low as 100 volts can result in degradation or catastrophic failure of a device. Ninety percent of static discharge damage is non-catastrophic. The device works okay right now, but may fail in a few hours or weeks of service!

In some shops, clerical or non-technical personnel may assist in unpacking and putting away arriving material. These personnel should be educated to a potential static discharge problem. To avoid possible damage to circuits, observe the following handling, shipping and servicing precautions:

1. All semiconductor materials should be stored or transported in conductive material (conductive bags, IC tube carriers and anti-static foam plugs) so that all exposed leads are shorted together. Devices must NOT be inserted into conventional plastic "snow" or plastic trays.

2. All work stations should be equipped with conductive table mats and floor mats (grounded work surface), conductive wrist straps or ankle straps or both, proper earth grounding, and grounded equipment.

3. Do not insert or remove modules with power applied. Power should be turned off in a pager before the printed circuit board containing the module is inserted or removed.

4. All low impedance test equipment (such as pulse generators, etc.) should be connected to CMOS device inputs after power is applied to the CMOS circuitry. Similarly, such low impedance equipment should be disconnected before power is turned off.

5. Manually operated spring-loaded desoldering tools should be all metal.

6. Soldering irons and desoldering stations should be equipped with zero voltage switching.

NOTES

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EPF-11413-A

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